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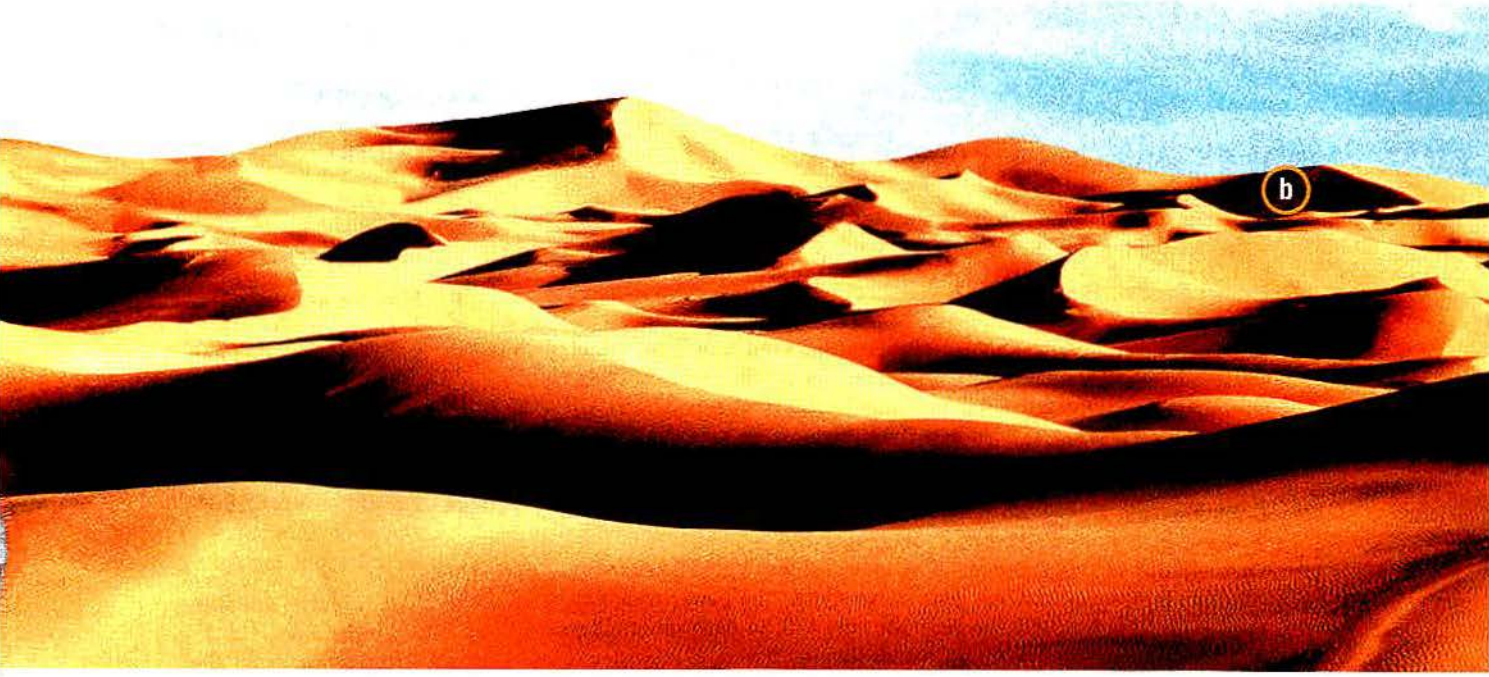
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CIRCLE 4 ON FAST FACT CARD.



On the cover: Contributing Editor Donald Koehler explores the possibilities for a communications medium that is somehow "beyond RF." Story on page 32.

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MOBILE RADIO TECHNOLOGY

MAY 2001
Volume 19, Issue 5



The Spokane sheriff's department uses GPS/AVL to track and catch a murderer. See page 18.

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Kari Taylor
Location technology expands beyond fleet dispatch to include suspect tracking and loss recovery.

32 Cover Story: Beyond RF
Donald E. Koehler
Telecommunications technology adoption has seen a millennium of smoke signals, dispatch riders and sempahore; 150 years of wireline telegraphy and telephony; and 60 years of commercial two-way radio. What service will your company be providing in 20 years?

38 Consolidation along the Cumberland
Leonard E. Leech and Robert T. Forrest, P.E.
Partnerships between public safety agencies and publicly-owned utilities may seem unlikely. But in Nashville, the power company, the fire department and the cops not only talk to each other, they also share the radio system on which they do it.

44 Happy 25th, IWCE!
MRT staff
This year marked the 25th anniversary of the International Wireless Communications Expo, held in Las Vegas in March. Between the booths, special events, seminars and prize giveaways, visitors were kept busy.



Nashville's utility and its public safety agency brought channels, funding and cooperation to the table to form one comms system. See page 38.

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Keep on dancing

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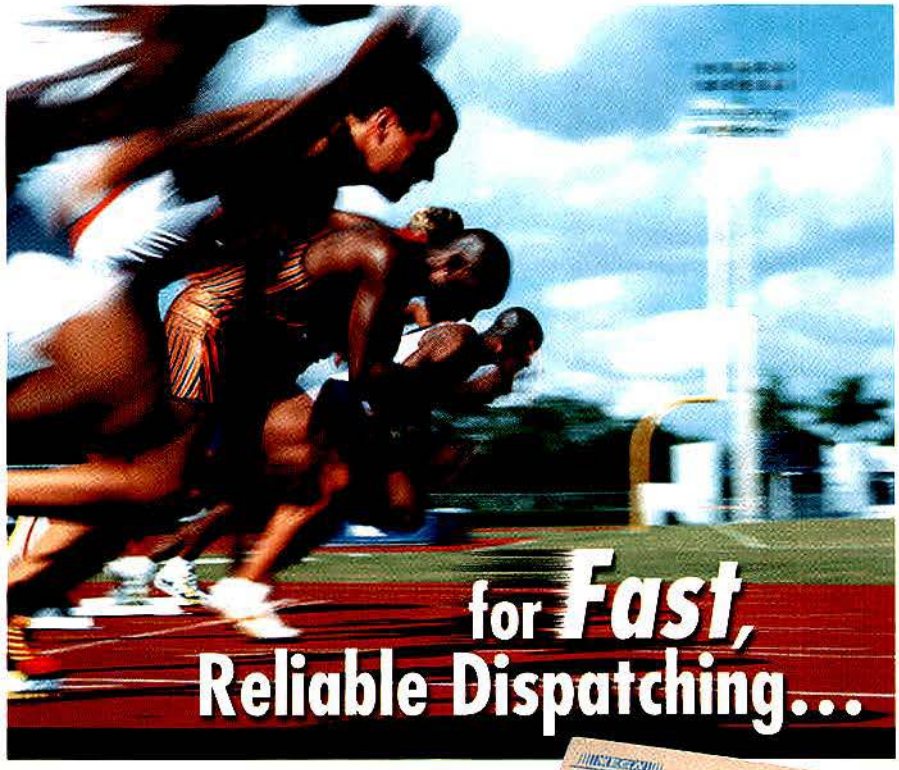
CIRCLE 5 ON FAST FACT CARD

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Let's improve our position in the marketplace

I appreciate and agree with the article you put together for *MRT* ("Radio Dealers Don't Communicate," *Point-of-Sale Perspective,* Bob Urian, February 2001). Certainly we have become a low-brow, low-tech industry made up of has-beens and wash-ups. As a 28-year-old sales rep for a very successful radio company, I am taken aback by the inept attitude of most dealers. I joined this industry because of the unique opportunity to sell mobile data and wireless data solutions. I work hard to position this company as a leader in wireless innovations. I agree that the lack of communications has turned us into a commodity market, just like cat-5 cable and fiber optics. This is an industry I used to be a part of, and it went from high profits to a complete commodities market. I agree we need to communicate more (or at all) and come up with a market strategy that plays on our strengths as a leader in wireless solutions. I am up for whatever we can do to improve our position in the marketplace. Let's add value back to our customers and win their loyalties through service; they will pay for it.

—Hudson Denney
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CIRCLE (6) ON FAST FACT CARD

Other dealers agree with Feb "POS"

I loved your article in *MRT* ("Radio Dealers Don't Communicate," *Point-of-Sale Perspective*, Bob Urian, February 2001). One thing I think you failed to mention was how the manufacturers push for territories but don't worry about those cataloged places that just sell the boxes. It is fine with the manufacturers because they make the money anyway. Just thought I would let you know that other dealers agree with you. Let me know if you get some kind of association together.

—Dan Shepherd
President
Vincennes Electronics
Vincennes, IN

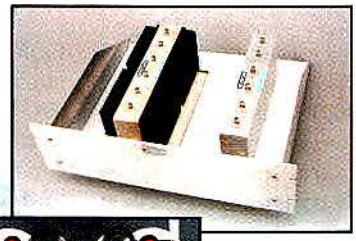
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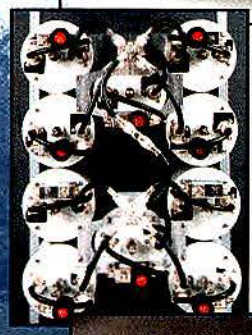
land mobile radio industry news, media, reader letters and people on *MRT's* Web site. Browse back issues or contact the magazine staff.

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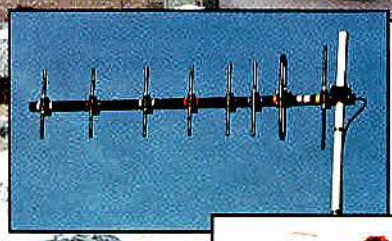
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CIRCLE 7 ON FAST FACT CARD

Interference? Let's hear it ... uh, *about* it

We've written about interference from wireless base stations that blocks reception on public-safety mobile and portable units. One reason for the problem is the distribution of wireless base stations throughout a population center, placing wireless transmitters close to public safety receivers that may not be able to reject the unwanted strong, nearby signal and to receive the weaker, desired signal from a distant public-safety base station.

Another form of interference from wireless base stations affects bi-directional amplifiers used to extend public safety radio coverage into underground areas and other weak-signal areas. Unwanted wireless base station signals, stronger by as much as 15dB or more compared to public safety signals entering bi-directional amplifiers, "rob" the power proportioned to desired public safety signals. The public safety signals are insufficiently amplified, and the result is that the bi-directional amplifiers' objective to extend coverage may fail.

Tyco must have made an offer that the privately held Com-Net's investors couldn't refuse, giving them a fabulous return on a 15-month investment.

If your agency has faced this type of interference, would you please let us know? We'd like to include some examples in a future issue that will offer solutions that work in various system configurations.

* * *

By the numbers

Intertec Publishing owns this magazine and the International Wireless Communications Expo trade show, operated by our Exhibitions Division. People who do business at the trade show express a lot of interest in the number of attendees. At press time, the Exhibitions Division released those numbers.

The verified attendance at IWCE 2001 was 7,547, compared to 7,342 at IWCE 2000. The numbers include show attendees and exhibitor staff.

In past years, Intertec has reported registration numbers, which take in everyone entered into the registration database. Registration numbers include those who preregister yet fail to come. Verified attendance counts only those who arrived at the show. Reporting verified attendance represents a change in policy for our company.



As for another set of numbers, this was the second year that we provided Internet coverage of IWCE. During the show week, 733 Internet users visited the *IWCE Live!* Web site. Visitors are counted once per visit, no matter how many pages they view. *IWCE Live!* users logged 4,606 page views. Friday had the most visits and page views. The coverage remains available for you to see on the Internet.

Meanwhile, check out our post-show coverage on page 44.

* * *

Tyco buys Com-Net Ericsson?

Representatives of Com-Net Ericsson, Tyco Electronics and M/A-COM are within an inch of confirming an agreement under which Tyco Electronics would acquire Com-Net Ericsson Critical Radio Systems and place it under M/A-COM's wing. *IWCE Live!* broke the story, followed by the Lynchburg, VA, *News & Advance*. (See **http//: content.intertec.com/newsletter/iwcelive/** "Word On the Street" and **www.newsadvance.com/MGB4I3GJ4LC.html**). Additional reporting appears on page 46. Watch for updates at **www.mrtmag.com.**

Tyco's spokesman said that the company doesn't comment on potential acquisitions. No one at Com-Net would comment, either, except to say that a government approval was pending. That probably means that the agreement has been submitted to the Department of Justice to review how the transaction might affect competition.

Com-Net Ericsson's acquisition of the former Ericsson Private Radio Systems Division was announced on Jan. 7, 2000. Its period of ownership has been brief and apparently successful. Tyco must have made an offer that the privately held Com-Net's investors couldn't refuse, giving them a fabulous return on a 15-month investment.

* * *

Happy trails

We say goodbye to Dennis Hegg, marketing manager for the western region. Dennis was with Intertec for 20 years and represented this magazine for 15. Dennis served our advertisers well, and his skill in helping them to advance their products and services was something to admire.

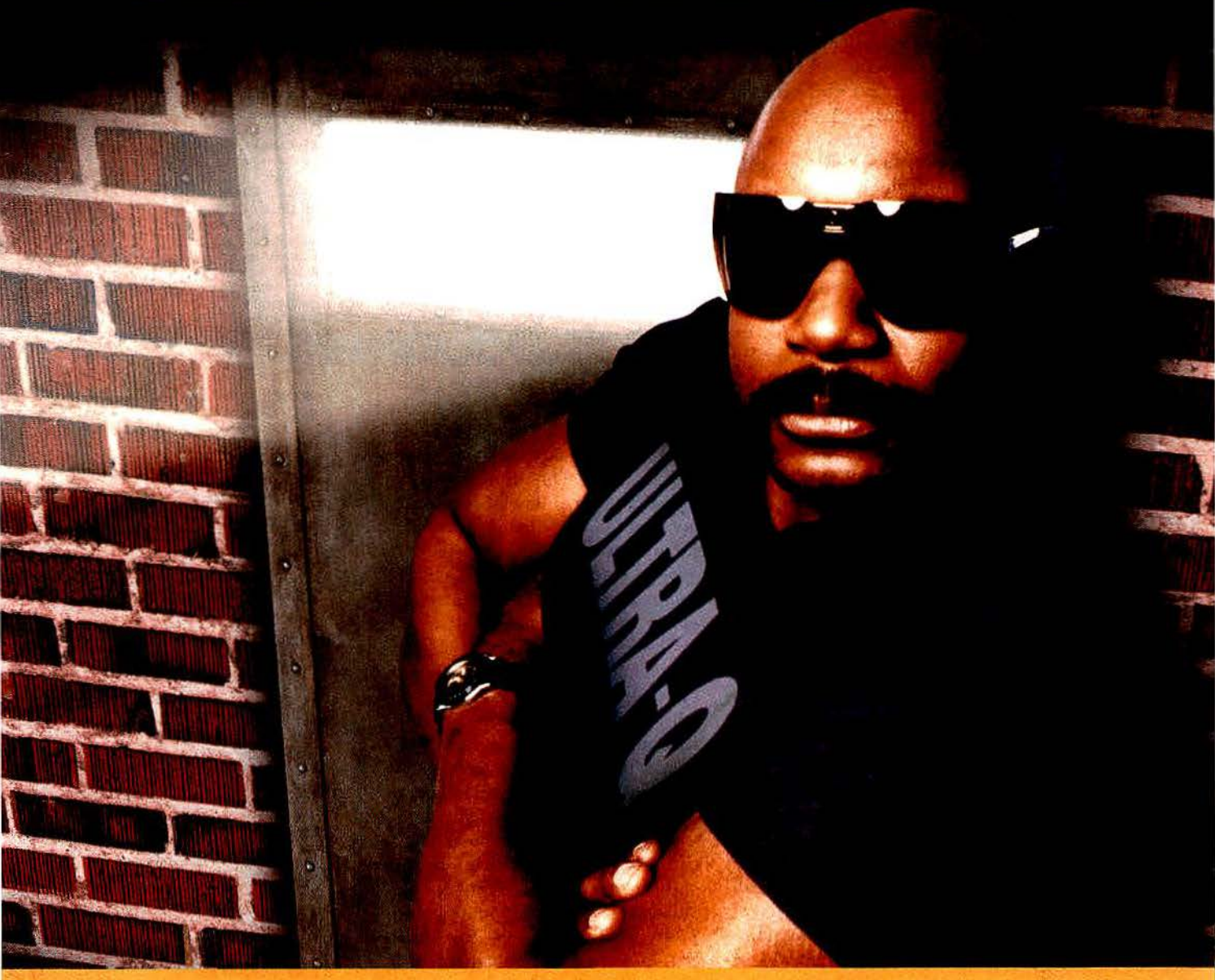
Plus, he's a cool guy and a good friend. We'll miss you, Dennis.

Don Bishop

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Follow me on this one



Last summer, I spent the day at a PSAP observing the management of radio traffic and listening in on the dispatchers' 9-1-1 calls. A few calls to the center were, of course, landline calls, and the caller's location appeared on the ALI screen. However, most calls that came in during that long afternoon were from cellphones.

The dispatchers explained that Good Samaritans often call when someone is in trouble—an accident occurs or a car breaks down—but many of the callers cannot give their location. At first that was difficult for me to comprehend: How could people not know where they are? Then I remembered the last time *I* tried to find my way home from downtown Kansas City and ended up in a less-than-safe part of town.

Absence of location capability jeopardizes public safety. Many people purchase cellphones for security, not realizing that if an emergency does happen, they may not be found if they cannot identify or describe their location. In February, a woman was trapped in her car after it ran off the Florida Turnpike and began to sink in a canal. She dialed 9-1-1, but she couldn't tell the call-taker where she was. She died.

ALI was designed for landline phones. It doesn't work yet with all cellphones, and most of the public doesn't realize that. In 1996, under pressure from the public safety community, the FCC adopted E9-1-1 location rules and set Oct. 1, 2001, as the deadline for cellular ALI capability.

Many people purchase cellphones for security, not realizing that if an emergency does happen, they may not be found ...

But will carriers meet this deadline? AT&T Wireless and Nextel have already filed for extensions. Nextel even told the FCC that it would give $25 million to APCO for dispatch centers (like a 16th-century indulgence) if the commission would just give it more time.

Technical obstacles to creating E9-1-1 services remain, but the technology to implement the service exists. If the FCC hadn't set *some* kind of deadline, the service would be delayed indefinitely, and more lives would be lost.

What is my own carrier doing to meet the deadline? Sprint PCS plans to comply with the mandate by rolling out ALI-capable handsets. Sprint observed in its implementation report that "the technological challenges to the development of such a system are phenomenal. The administrative, logistical and financial issues are even more formidable." Sprint also pointed out that, as a service provider, it doesn't manufacture handsets, base-station transceivers or switching equipment.

The FCC has a scarcity of engineers, and the commission often issues orders and passes rules without appreciating the technical feasibility of compliance. But the officials from APCO and NENA, who have called for this mandate, contend that the technology exists.

By forcing this issue on carriers, the FCC has the public interest at the forefront. As technology advances, carriers can update equipment and networks for more cost-effective and accurate results. They will also find ways to exploit this mandatory capability for additional applications—for profit.

In the meantime, if someone carjacks my vehicle with me in it, and if I can dial 9-1-1 without his knowing it, I'd like the dispatcher to know where we are going. We may be heading into downtown Kansas City.

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CIRCLE 9 ON FAST FACT CARD

Playing on the market slide

By Robert H. Schwaninger Jr.

I looked at my stock ticker this morning. When the indexes are up, the numbers are a lovely shade of green. And when they're down, the numbers are bright red. For the last week, [mid-March], the numbers have been flashing more red than a 12-alarm fire. In the first hour of trading, the Dow fell farther than spit over the edge of the Grand Canyon.

Should we be worried? Sure. After all, the business reporters tell us that it's a "bear market," as though likening it to a woodland



Illustration by John Hayes

"Another drink for my friend Robert here!"

creature makes it better. I've got money in mutual funds (or at least I *had* some before this morning). The way things are going, the Standard & Poor's Index is going to live up to its name.

As for wireless stocks, they're leading the charge—to the rear. The question is, how come? Why is it that the most dynamic industry in the country is in the doldrums, dragging down equipment manufacturer performance, tower company stocks and technology houses' hopes? Well, one theory is that:

The global marketplace dynamic of earnings/price flow margins when compared to the PE of other segments and taking into account the sell-off of lower Kosovo bond issues to leverage the buy-but-not-build of 3G technology, when applied to the influx of profit takers during a time of economic uncertainty, caused a guy named Murray to laugh so hard that soda came out his nose and shorted out the green button on the stock ticker thing for everyone's computer.

I've got a different idea. It's called "stupidity." You see, when a bunch of companies do stupid stuff and cover it up using shareholder money, then earnings go down and the stocks go down. If enough companies in a given market segment do enough stupid stuff (and they *do* imitate one another) so that everyone's earnings start to suffer, then the entire segment takes a tumble.

So, what stupid things did the publically traded wireless companies do that might have let the bear loose in the market? Here's my top five, but I'm sure there's more:

1. They weren't sufficiently forthcoming with analysts regarding the cost and time required for systems build-outs vs. the revenue expectations.
2. They didn't take into consideration how increasing competition would affect revenue-per-customer numbers.
3. They let themselves believe that there is a one-to-one ratio between emerging technology and

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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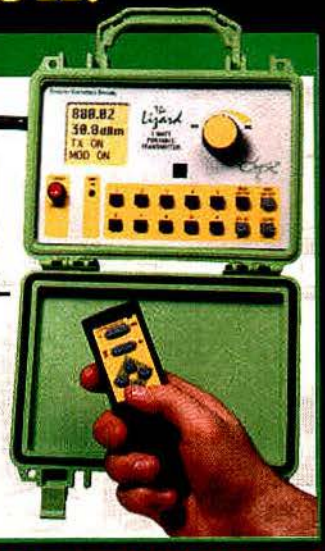


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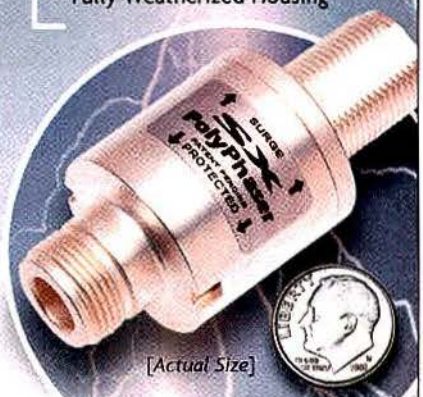
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CIRCLE (11) ON FAST FACT CARD

market share (or revenues).

4. They booked spectrum as an intangible asset with values that reflect long-term potential rather than short-term cost.
5. They forgot about *profit*.

Between 1995 and 2000 you could have raised a zillion dollars in the public market to build-out any wireless system that had even a remote potential of delivering wireless Internet access (the "killer app"). These broadband ideas (and we're not talking the Dixie Chicks) fueled FCC auctions. They also ran spectrum prices up until profitability was so far in the future you couldn't see it with a dozen crystal balls.

The game was changed so severely that companies no longer announced the time period to profitability. Instead, they announced the expected time period until they could pay operations costs and debt service with other-than additionally borrowed money. If you did the math, most of these companies didn't expect to reach profitability until they had borrowed an amount roughly equivalent to the French treasury.

Underlying these activities was the One Big Stupid Idea: The American economy would see continuing growth (of previous rates) in the percentage of disposal income used to purchase wireless telecom products. Or, more simply, if you build it, people will buy it. Tell that to Teligent, PSINet and Metrocall.

So, what's the solution? Reality. Let's be realistic about where the industry is and where it's going. The industry is in a growth spurt. Just like raising a teenager, the cost of managing growth spurts is awfully high. Try to make a profit on feeding and clothing your high-school kids. Forget it.

During the past few years, the wireless industry has been footing the bill to construct and operate systems that are not presently profitable but have a rosy future (just like that high-school kid). But its capital expenditures are exceeding expectations, and profitability appears to be moving farther away, not closer. Meanwhile, the industry threw itself lavish parties on the deck of the Titanic, and now some people cannot understand why the food is soggy.

The fact of our industry is that it takes a lot of money and time to make a lot more money over time. It requires industry cooperation, standardization and interoperability to reduce the ravages of technological competition that make products and balance sheets obsolete. It also requires honesty.

An honest person would affirm that many more new services will be delivered in a wireless environment. Those services will add mobility and efficiencies to business and personal activities. That same honest person would also have to admit that a fully integrated, reliable delivery system is still in the future. An honest person would also recognize that although there is healthy demand for high-end, broadband services; the wireless market does not begin and end there. Many consumers are looking for lower-cost solutions.

The industry is in a growth spurt. Just like raising a teenager, the cost of managing growth spurts is awfully high.

Before the market rights itself (it's rather depressed now), wireless carriers will be scrambling for creative ways to meet their capital-expenditure needs. Systems build-outs must and will continue—possibly at a more rational pace. If this means that financial analysts must adjust their expectations to fit a more logical scenario of long-term growth, rather than short-term stock price spikes, OK.

In the meantime, look for bargains on Wall Street (they're there), and be patient. Remember, although publicly traded wireless companies have enjoyed the salad days of mass stupidity, they're coming around. Oddly enough, they are starting to run their businesses just like yours. ■



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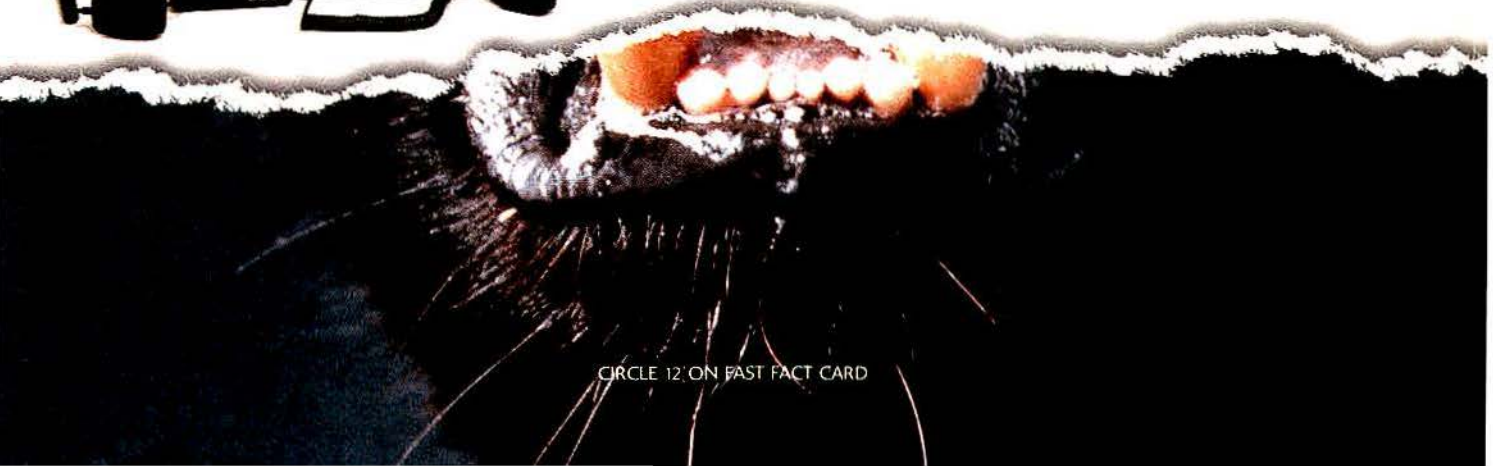


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CIRCLE 12 ON FAST FACT CARD

How I spent my spring break

Opinions and ideas from IWCE 2001.

By David O. Dunford

I always perform a balancing act when attending a radio industry trade show. It isn't as sophisticated as a "delicate balance"—it's more like dancing elephants. A case in point was the International Wireless Communications Expo this year. On one hand, a nearly endless collection of interesting exhibits and vendors with technical staffers were present to answer technical questions and to provide factory insight. On the other hand, there was a plethora of pertinent (if not interesting) seminars and presentation sessions.





MRT's public safety consultant David Dunford ran across an "endless collection of exhibits and vendors" at IWCE. He also learned several new terms, including "booth babes."

For readers who were unable to attend IWCE this year, there was also *IWCE Live!* (link to the site through **www.mrtmag.com**) on the Internet, which provided timely updates and insights from the show floor. This year's show also saw several private firms hosting detailed "infomercial" sessions covering the technical intricacies of their respective products and services.

The problem was that all this concentrated brilliance was floating around at the same time, and my brain filled up pretty fast. I did learn three new trade show phrases, at least one of which could be routinely worked into normal conversation. First was "booth babes" for the lovely women hired to draw in attendees. Second was "apps" for appetizers, as served in hospitality suites. Third was "bladder buster" for the 32-oz. drinks often sold in convenience stores.

I also talked to everyone who would listen about the future of the industry in general, prospects for paging, cellular and land mobile (now called dispatch, courtesy of Nextel) in particular, and insight about the future of public-safety systems.

Kathleen Wallman, keynote speaker at the show's opening session, discussed future challenges and provided several "good" examples of service provision. Tom Tolman narrated a session discussing interoperability. Another session with Wallman and Tolman covered 700MHz systems.

Several APCO officials were at the show, and there was an afternoon-long presentation about TETRA, the European-led consortium standard for Terrestrial Trunked Radio. So, based on what I heard, saw and discussed, I'm hereby offering my first post-show opinion register. (This isn't a report or a synopsis—it's only my opinion, of which I have several.)

Dunford, *MRT's* public safety consultant, is technical services consultant for the Lenexa, KS, police department. He is a member of the Association of Public-Safety Communications Officials–International. You can email Dunford at **mrt@intertec.com**.

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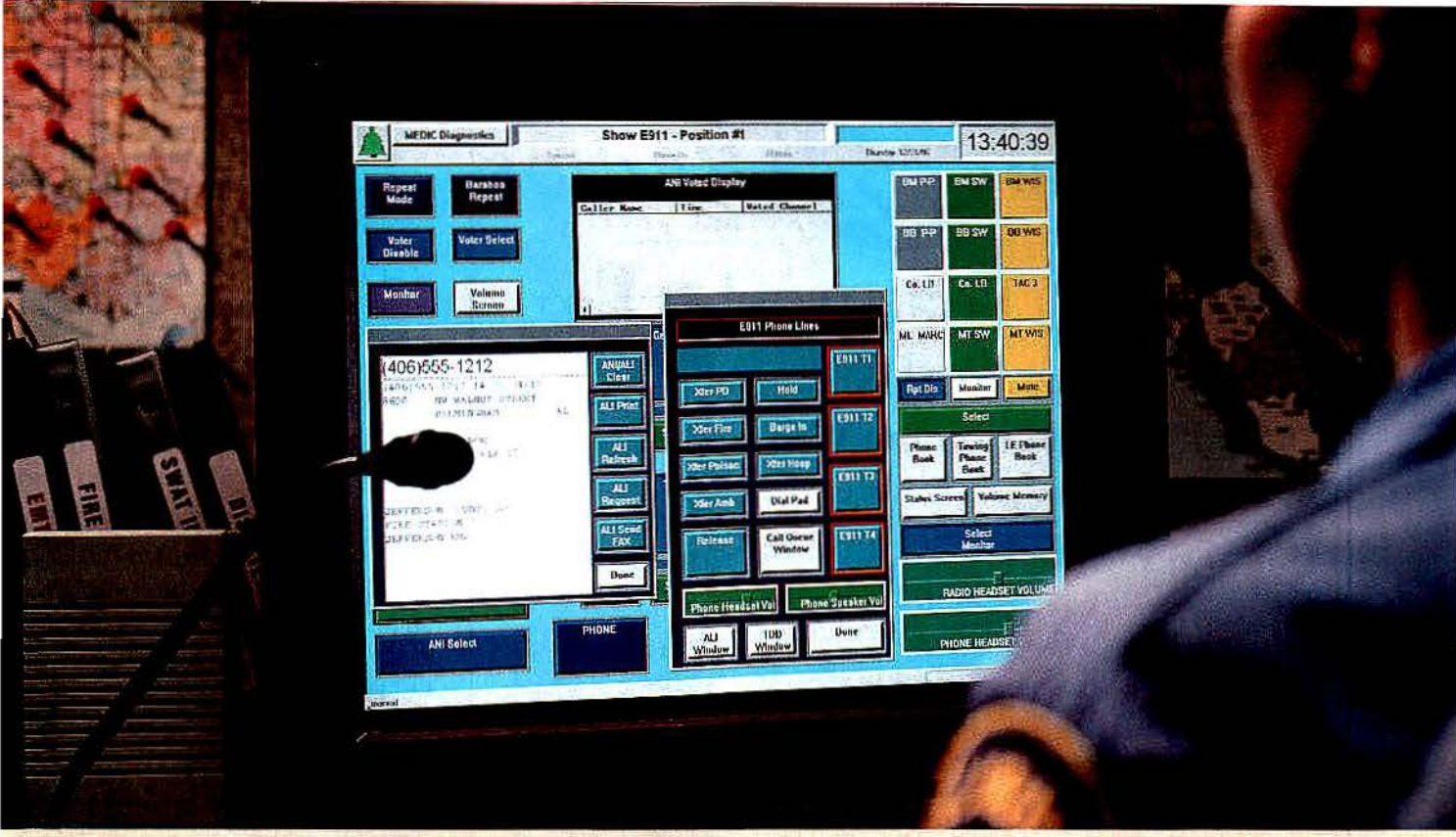
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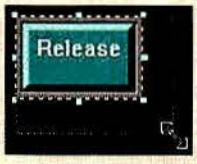
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CIRCLE (15) ON FAST FACT CARD

First, there continues to be a steady push for blanket public-safety migration to the 700MHz band. It appears that there is also a concurrent push for a government-driven technical standard for operation in this band. My opinion is that "irrational exuberance" for either of these ventures will yield a proprietary, disproportionately expensive technical solution for any migrating public safety agency. Generally, local public safety doesn't have the price of admission to this unnecessarily expensive "technology buffet."

Public safety doesn't need to worry so much about radio and communications interoperability; it needs to worry more about *workforce* interoperability.

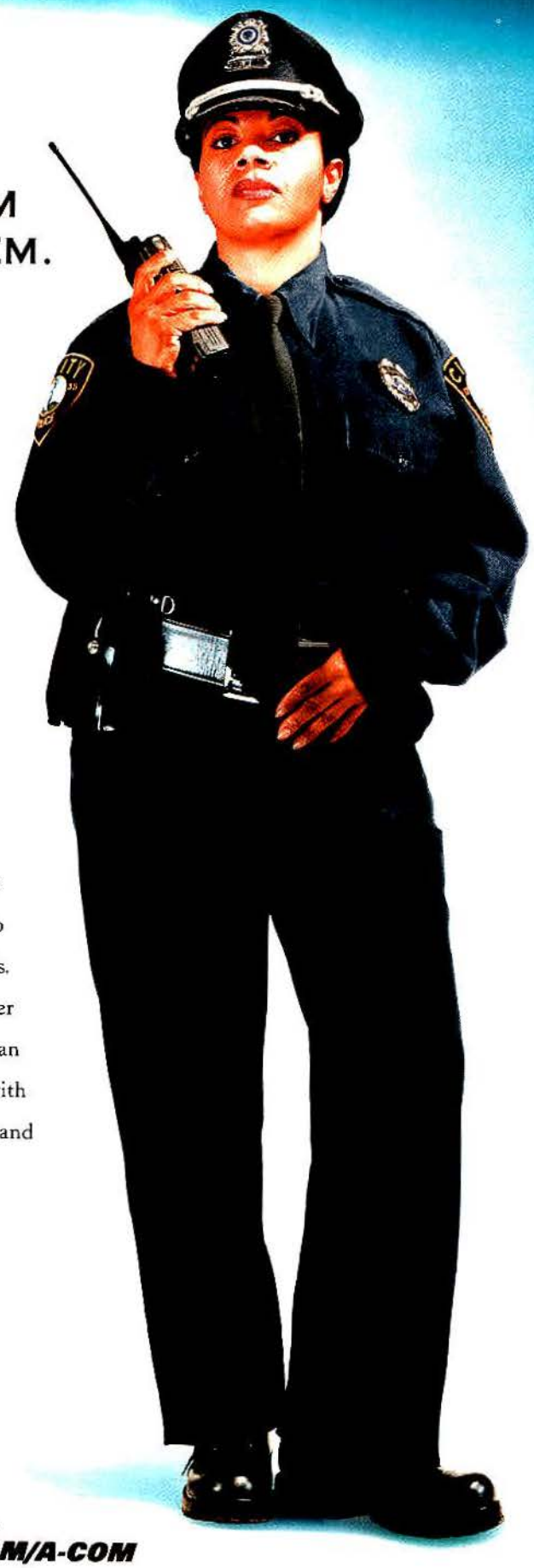
Second, public-safety needs must and will embrace integrated computer applications involving mobile data. The importance of data will grow, and the prevalence of voice radio will shrink.

Third, public safety doesn't need to worry so much about radio and communications interoperability; public safety needs to worry more about *workforce* interoperability. The fire service is already attuned to this concept with Unified Command and the Incident Command System, which allows complete scalability of incident management. Police are less adept at this concept but only because we are taught to think and act predicated on an individual response. Public-works departments are critical to an incident response and, for the most part, have been too busy working and doing their daily jobs to focus on ICS.

Fourth, public safety will need to begin doing what surviving businesses do: develop liaisons and new business partnerships. For example, *if* Nextel were to provide a software-partitioned, public-safety "sub-net", and *if* the price were reasonable, then public safety *might* have a new, different and valuable wireless tool. ■

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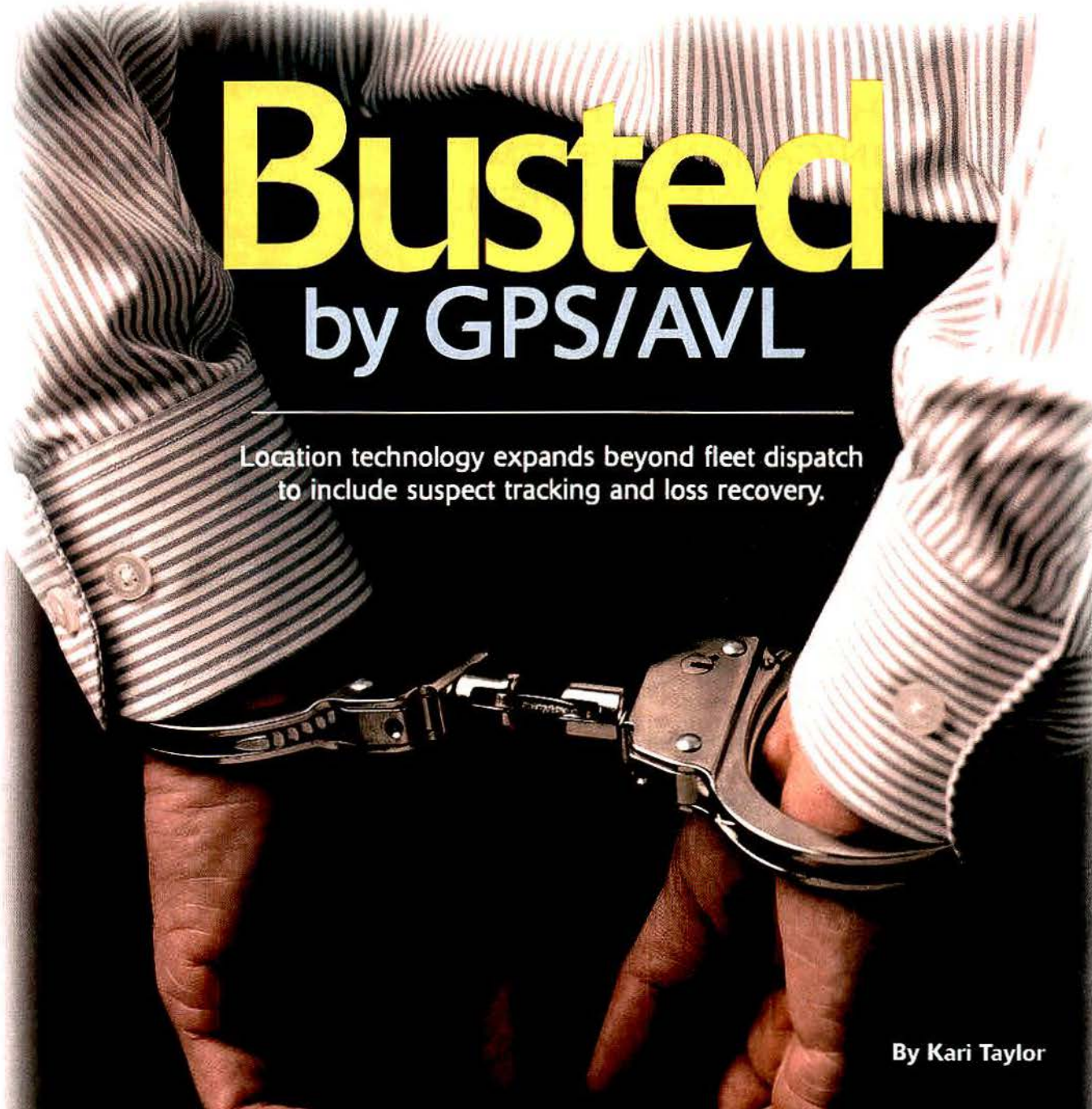
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CIRCLE 16 ON FAST FACT CARD

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Busted by GPS/AVL

Location technology expands beyond fleet dispatch to include suspect tracking and loss recovery.



By Kari Taylor

A nine-year-old girl was missing in Spokane, WA. The Spokane sheriff's office suspected that she had been murdered but they couldn't find her body. They believed the only person who could be responsible for the girl's disappearance was her father, based on circumstantial evidence against him. He was also the only one at home when the girl disappeared. Unfortunately, the investigators had no evidence to confirm the father as the offender.

During this investigation, the sheriff's office received three GPS/AVL units on loan for evaluation from the U.S. Army Counterdrug Technology Assessment Center/Technology Transfer Program. The sheriff's office had requested the equipment to help fight local drug traffic. In return, the sheriff's office would assess

Taylor is associate editor. Her email address is ktaylor@intertec.com.

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SS-30	25	30	3¾ x 7 x 9⅜	5.0



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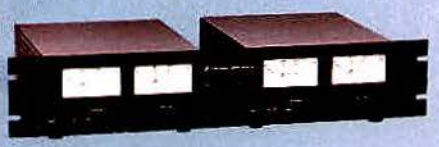
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SRM-25	20	25	3½ x 19 x 9⅜	6.5
SRM-30	25	30	3½ x 19 x 9⅜	7.0

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SS-10V, SS-12V, SS-18V

CIRCLE 17 ON FAST FACT CARD

*ICS – Intermittent Communication Service

the equipment's effectiveness for the Army. The equipment included ISR's Fleettrack, which uses GPS to locate fleet vehicles. It can also be used to target a specific vehicle.

The homicide detective working on the missing-girl case asked Don McCabe, a detective in the sheriff's drug enforcement unit, if he could borrow a GPS receiver to monitor the father's whereabouts. Homicide detectives hoped the father would lead them to the girl's body or at least to some evidence that would further implicate him, or eliminate him, as a suspect.

After 18 days of tracking the suspect around Spokane, the police located him on an old logging road where he used to hunt.

The Spokane sheriff obtained a search warrant that allowed GPS receivers and location transmitters to be placed on two of the father's vehicles. Detectives tracked the suspect, using the tracking software installed on a Gateway 350 desktop computer and on a Gateway laptop that was equipped with a cellular data link so that mobile officers could participate. The displays were set to show changes in position every 15 seconds.

After 18 days of tracking the suspect around Spokane, the investigators located him on an old logging road where he used to hunt. It was there they later found the girl's body buried about 50 feet off the road.

Spokane's sheriff's drug enforcement unit had not had an opportunity to use the tracking equipment before Homicide had borrowed it. However, observing Homicide's successful application, Det. McCabe said it was "Definitely worthwhile to use again in future crime cases."

GPS/AVL properties

GPS was developed as a worldwide navigation and positioning facility for military and civilian use. It uses satellites that orbit the Earth and constantly transmit their precise time and position in space. After determining its relative position to several satellites, a GPS receiver can determine the exact location of its host vehicle using triangulation techniques.

ISR has been installing GPS/AVL systems for government and commercial customers since 1986. Some of its customers include the U.S. Army, the FBI, the Mayo Clinic, and the General Motors Proving Grounds. ISR developed the Fleettrack system in 1995. The system's features are upgradable to allow more receivers to be added and tracked as fleet needs grow. As many units as needed can be managed. The standard configuration allows users to track vehicles in real time or to play back a record log at a later time. Analysis of the



CIRCLE (18) ON FAST FACT CARD



CIRCLE (19) ON FAST FACT CARD

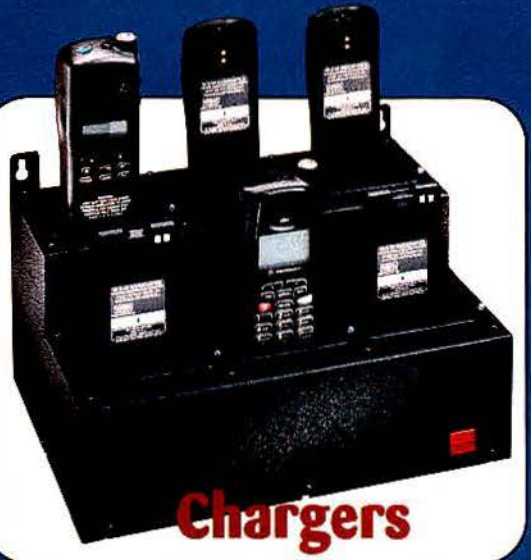
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CIRCLE 20 ON FAST FACT CARD

playback can be used to schedule fleet operations. The system continuously records real-time data about a truck's operations, including speed and location. It notifies dispatchers when a truck deviates from a planned route, leaves a specific zone or is standing still for more than 15 minutes (or any other pre-set time).

A new version of Fleettrack offers automatic switching of data transmissions from cellular digital packet data to an analog cellular network. This improvement to the hardware and software can cut operation costs because the system discriminates when to switch from CDPD to more expensive analog coverage channels. An example would be if a vehicle moves out of range. CDPD has been deployed in more than 70 major metropolitan areas in recent years, but as vehicles leave these densely covered urban areas, they move out of CDPD's range. When that happens, fleet managers must rely on an analog cellular network, which, on average, can cost between 10 to 20 times more than CDPD for position updates.

The tracking software now offers more options for a user to display maps, to conduct two-way messaging with radio units, to monitor vehicles for safety and to generate reports. By clicking on an icon, fleet managers can communicate with a specific vehicle, control location sensors implanted in the vehicle, and load or scan vector maps into the system. An entire fleet can be tracked simultaneously. Managers can also remotely monitor data inputs such as speed, refrigeration temperature and door locks status in real time.

For driver and property protection during emergencies, the tracking system includes remote in-vehicle panic buttons. Because of its compatibility with other software applications, the system also allows reports to be generated. The tracking system can be run from a notebook computer in a mobile dispatch unit or from a PC in a central dispatch facility. The system is compatible with most leading radio, cellular and satellite sensors.

Loss recovery and prevention

Fighting crime is a dirty business, but one sanitation company used GPS/AVL to clean up a criminal's act.

All-Cycle Sanitation of Woodstock, GA, had initially installed a Fleettrack system to locate its trucks at the beginning of a workday. Drivers often took the trucks home at night to get an early start on collection routes that began before daybreak. The company had no idea it would one day help

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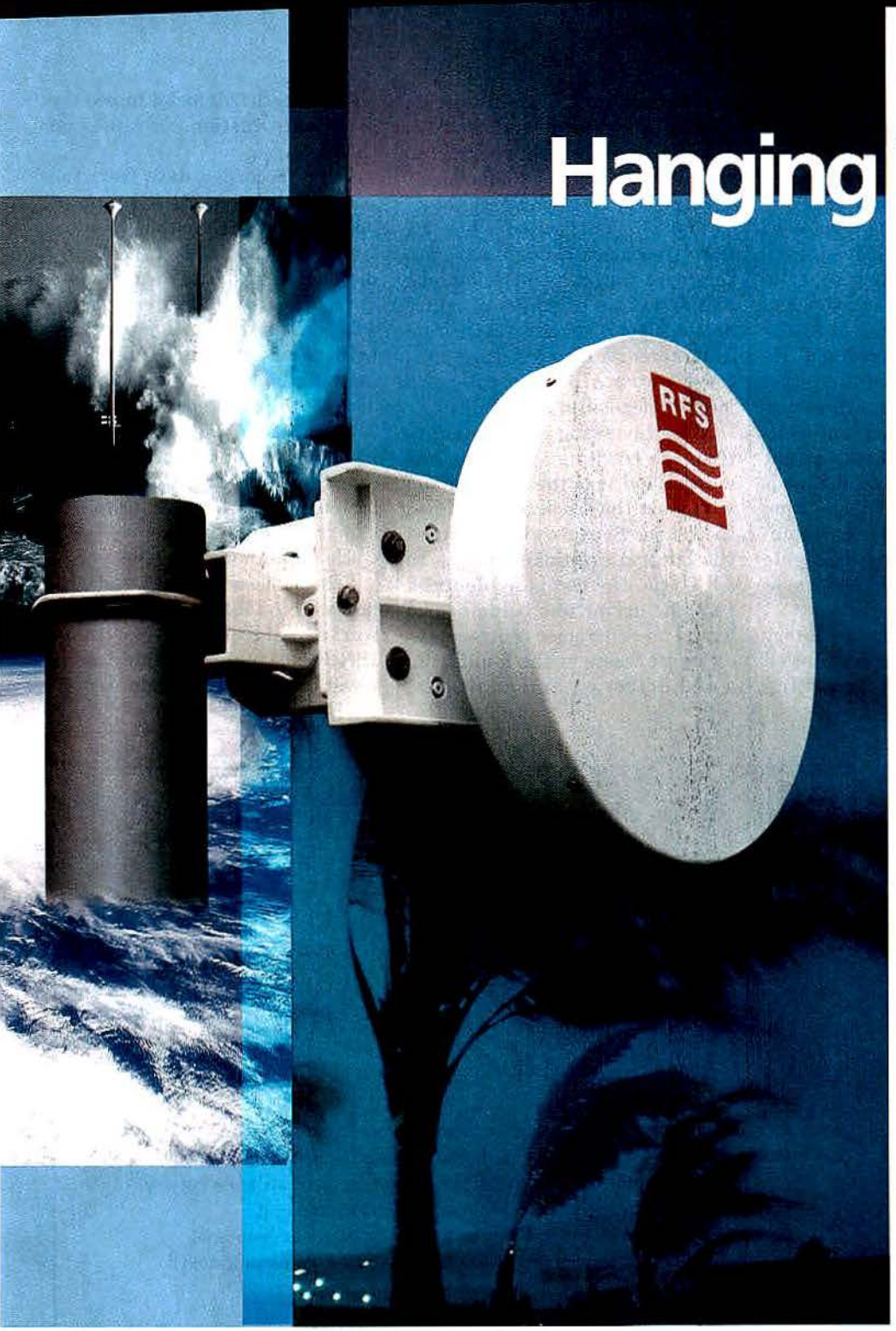
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CIRCLE (22) ON FAST FACT CARD

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them catch a thief.

One morning last year Anthony Grutadaurio, co-owner of All-Cycle Sanitation, noticed on his computer monitor that one of his trucks was *moving* when it should have been *parked*. Grutadaurio called his dispatcher to find out if the truck had been ordered onto the road, but it had not. He then checked the travel data report that the tracking system compiles. The truck's recent activity showed that it had been moving during off hours between a sanitation facility where All-Cycle dumps its client's refuse and a non-customer construction site.

Between the stolen truck and the containers, the tracking system saved All-Cycle more than $140,000.

Grutadaurio's partner, Barry Skolnick, got in a car and tailed the truck, using the tracking system as a guide. Eventually he caught up with the truck and followed it until the police arrived to arrest the driver on a theft charge. The excitement wasn't over yet.

The plot thickened when an irate Woodstock resident called to complain that an All-Cycle truck had dumped a container of refuse on his street. The refuse came from a customer's construction site, from which All-Cycle collected loads to deposit in a landfill.

After reviewing historical data from the tracking system, it was determined that the same person who stole the truck also dumped the refuse. Because all deposits at the landfill are ticketed back to All-Cycle, the company deduced that the driver was being bribed by the non-customer contractor to dump its waste at the landfill. To avoid detection and additional billing, the driver just dumped the legitimate customer's refuse on the streets.

Using recorded data from the tracking system, All-Cycle pinpointed the non-customer's location. At that site, All-Cycle discovered six of its own new 40-yard capacity containers—filled with debris. Because empty containers are warehoused at the landfill, the truck driver had easy access to the units. These six containers, worth $25,000, might not have been found without the tracking playback. Between the stolen truck and the containers, the tracking system saved All-Cycle more than $140,000.

"The police were impressed with how well the ISR Fleettrack really works," said Skolnick. "Without ISR Fleettrack, we would have never uncovered the scam." ■



CIRCLE (23) ON FAST FACT CARD

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Practical notes on the ferrite isolator

By Harold Kinley

An isolator is sort of an RF lobster trap. Unidirectional, it isolates a source and load so that any reflected energy at the load is trapped or dissipated.

The photo below shows a single-section ferrite isolator. There are three ports, labeled "1," "2" and "3." Port #1 is the input port, port #2 is the output port and port #3 is the load port. The input (from the transmitter or source) is applied to port #1. The output (to the antenna or load) is taken from port #2. The dummy load is connected to port #3.

The direction of power flow is



A single-section ferrite isolator. *Photo courtesy of Decibel Products, Dallas.*

from input (port #1) to output (port #2) as shown by the arrow on the maker's plate. Any power that is reflected from the antenna or from some other load appears at port #2 and is directed to port #3, where it is dissipated in the 50Ω dummy load. If the isolator is properly tuned, the amount of reflected power appearing at the input port will be small.

Contributing editor Kinley, *MRT's* technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques,* which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. Kinley's email address is **hkinley@home.com.**

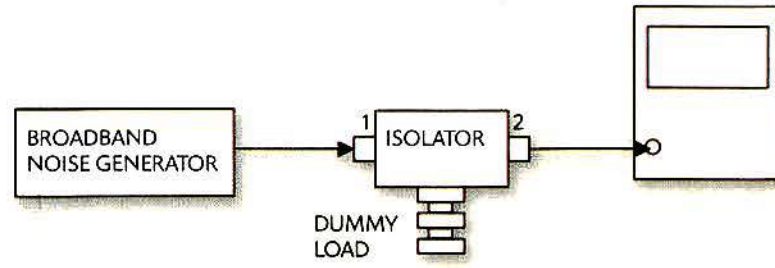


Figure 1. A broadband noise generator is used to check the frequency response of this isolator in the forward direction.

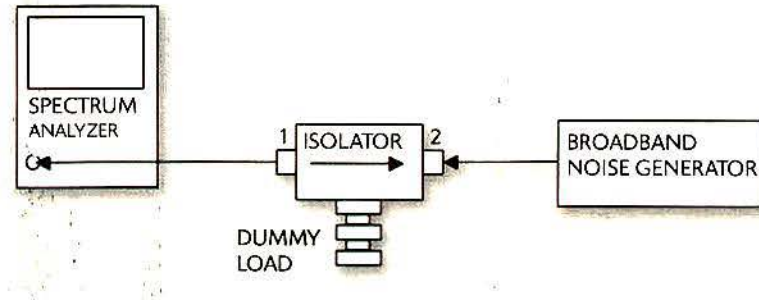
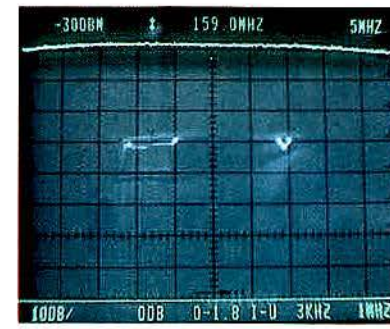


Figure 2. A broadband noise generator is used to check the frequency response of this isolator in the reverse direction.

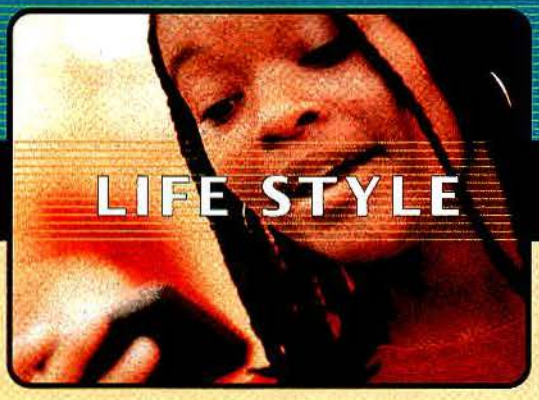
Figure 1 above shows a test setup in which a broadband noise generator is used to view the response curve of an isolator in the forward direction. The frequency response in the forward direction is quite broad, as shown in the photo at the right. Figure 2 above shows the test setup for viewing the response of the isolator in the *reverse* direction. The photo on page 28 shows that the return loss or isolation is highest at the resonant frequency of the isolator, but it is still good at frequencies well removed from the center frequency.

Normally, the isolator is used immediately at the output of a transmitter, as shown in Figure 3 on page 28. An isolator's primary function is to prevent signals from nearby transmitters from entering its transmitter's final stage where they might mix with the transmitter signal or harmonics to produce strong intermodulation products. Such intermod products might cause interference to collocated receivers. A secondary function of the isolator is to provide the transmitter output with a constant 50Ω load impedance. Because the isolator dumps off any reflected power to the dummy load, the transmitter sees a near-perfect load impedance.



The frequency response in the forward direction is quite broad.

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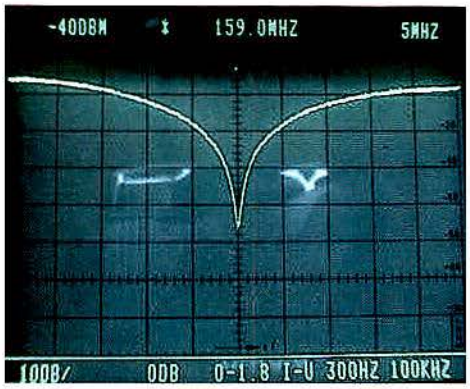
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The return loss or isolation is highest at the resonant frequency of the isolator but is still good at frequencies well removed from the center frequency.

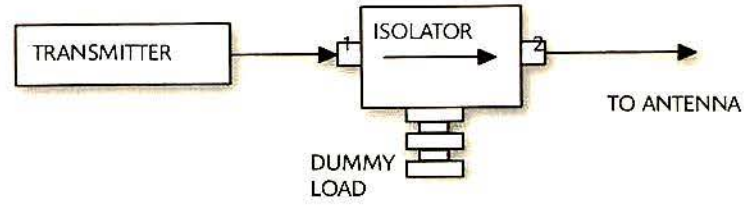
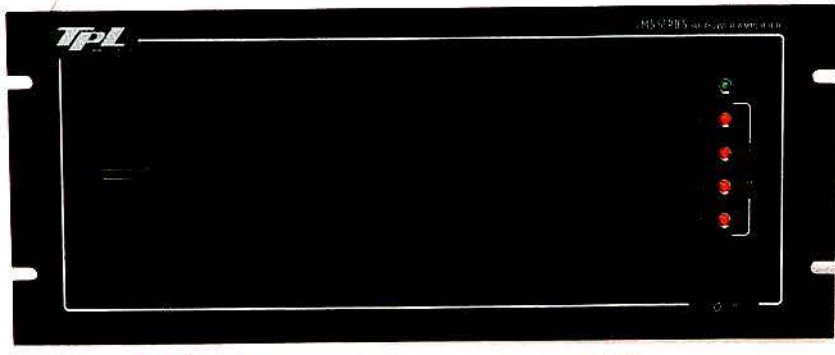


Figure 3. The isolator is connected directly to the output of the transmitter with the #1 port connected to the transmitter and the #2 port connected to the antenna. Any reflected power is dumped into the dummy load.

It is important that the dummy load of the isolator be large enough to handle any power that is reflected back into port #2 of the isolator. Let's say that the transmitter output is 100W, and that the line loss is 1.5dB. The power appearing at the antenna is about 71W. Assuming a worst-case mismatch at the antenna, 71W is reflected back down the line. Because this reflected power again encounters the line loss, the RF power appearing at port #2 of the isolator is 50W. If the dummy load of the isolator is rated at 50W, then the reflected RF power will be safely dissipated in the dummy load, and the transmitter will never see the mismatch. However, if the dummy load connected to port #3 of the isolator is rated at only 25W, then it will soon overheat and things will go haywire.

Heat is an enemy of the isolator.



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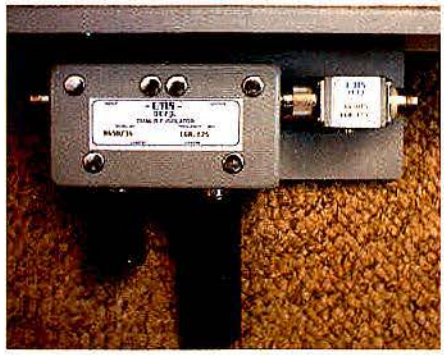
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The dual isolator has a larger dummy load connected to the side of the isolator that is close to the antenna line.

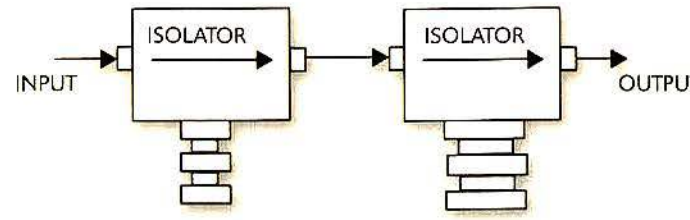


Figure 4. Two isolators can be connected in cascade as shown here to increase the amount of isolation. Make certain that the larger dummy load is located on the isolator nearest the output or load side.

So, it is important that the power rating of the dummy load be sufficient to handle a significant level of reflected power. As a rule of thumb, the power rating of the dummy load is chosen to be about 50% of the transmitter power output rating. You will see dummy loads that are attached directly to the isolator and those that are mounted away from the isolator. Dummy loads that are mounted away from the isolator tend to reduce the amount of heat transferred to the isolator in cases of high reflected power.

Isolators can be connected in cascade, as shown in Figure 4 above, to achieve a higher degree of isolation. When isolators are connected in cascade, the dummy load on the isolator that is connected to the antenna should be of a higher power rating. This is because it is the first line of defense and will receive the full reflected power (minus the small amount of insertion loss between ports #2 and #3). An alternative to connecting two isolators

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CIRCLE (28) ON FAST FACT CARD

in cascade is to use a dual-section isolator, such as the one shown in photo at the left. As part of the intermodulation panel, a dual isolator is more efficient because it is manufactured *as* a dual isolator. The tuning is also more precise, with less insertion loss. Notice in the photo on page 30 that the dual isolator has a larger dummy load connected to the side of the isolator that is close to the antenna line. Also, notice that the isolator is followed by a lowpass filter between the antenna line and the isolator. This is because isolators tend to generate weak second harmonics and should always be followed by a lowpass filter to prevent these harmonics from reaching the antenna.

Several precautions should be observed when installing an isolator. Don't exceed the power input rating of the isolator. Use a dummy load that is at least 50% of the rated transmitter power output. If possible, use a dual-section isolator rather than cascading two single-section isolators. For maximum isolation, tune the isolator to the specific frequency of a particularly troublesome collocated transmitter. Follow the manufacturer's instructions on mounting the isolator. Some isolators might be detuned when mounted on the surface of a ferrous metal. Always follow the isolator with a lowpass filter.

By using an isolator on the output of a transmitter, many interference problems can be avoided—especially at densely populated transmitter sites.

Until next time—*stay tuned*! ■

Feedback

Some feedback about the column on Stabilant 22A:

Bruce Hislop, president of Perth Communications, Stratford, Ontario, writes: *I have been using it (Stabilant 22A) for years, since the GE Phoenix days. Remember those miserable, noisy, molex connectors in those radios? Stabilant got those radios working reliably. Also fixed those GE MPI audio board connectors for good, too. And not to let Motorola off the hook, it settled down the unstable VCOs in the MCX100! I can't recommend it enough. I use it everywhere. Try it on shields, to reduce noise, and all those fussy little connectors out there. The price of the stuff might shock you, but you only need a drop, so the little bottle lasts a long time.*

Another reader, Mike Moran, CET, writes: *Just read your article in the February* MRT *and wanted to share my experiences. I've used Stabilant 22A and some other products for about 10 years and found them to be well worth the money. One example: Back in the early '90s I was a public-safety tech. We had quite a number of Motorola KDT-480 mobile data terminals in our service base, and the most common problem was the unit refusing to boot when turned on, showing an "ERROR 08" on the screen. The logic units were trunk-mounted, and the universal fix was to remove them, disconnect and reseat all the connectors, and "crunch" all the socketed chips. Most of the time this worked, but on the ones that it didn't, we'd disconnect all the connectors and remove all the chips, then treat all the pins and sockets with Stabilant 22. I never saw this technique fail to bring a unit back to life, and the treated units generally never showed up again with that same problem. I've used Stabilant in a number of applications, along with the products of Caig Laboratories (**www.caig.com**) that offer a wider range of products. Based on my experiences, I can recommend both as useful shop tools, especially for those maddening come-and-go intermittents.* ■

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CIRCLE (29) ON FAST FACT CARD



What *is* Beyond RF?

Telecommunications technology adoption has seen a millennium of smoke signals, dispatch riders and semaphore; 150 years of wireline telegraphy and telephony; and 60 years of commercial two-way radio. What *service* will your company be providing in 20 years?

By Donald E. Koehler

Spectrum has become a semi-precious commodity. Telecom applications gobble bandwidth like popcorn, and the world's governments parsimoniously distribute access. When we exhaust technical fixes, like refarming and narrowbanding, what will we do to keep loading users?

New spread-spectrum technologies continue to emerge, such as ultra-wide-bandwidth impulse radio, which may be able to overlay communications on existing frequencies. But what will telecom life be like—someday—*after* radio? Will the world's telecommunications requirements force or drive us to move *beyond* RF?

"Beyond RF" ... There is a strange ring to that pair of words. I will skip the impractical references to pulp science-fiction and TV starship heroes and focus on the possibilities for a communications medium that is somehow "beyond RF."

(Editor's Note: If it wasn't for radio magazines, we might not have contemporary science fiction. In the 1940s,* Radio-Electronics *magazine Editor Hugo Gernsbach started filling in

Contributing Editor Koehler is a network operations manager at a major Alaskan communications corporation. His email address is AFDEK1@uaa.alaska.edu.



A (short) journey into possible futures

the back of his radio publication with speculative-fiction essays. This gave rise to the birth of serious American science-fiction magazines and writing, the most prestigious award for which now bears his name: the "Hugo.")

In the 1950s, the famous author Robert Heinlein wrote a novel wherein he speculated on what he called "additional spectra": magical energies that, once controlled, could cure or kill. The energies we use to communicate with *today* could meet his definition. Let us take a stab at this subject and, as a bonus, spend some time speculating on what it would take to make any of this commercially viable.

Let us begin with the notion that *communication* takes place when two individuals *exchange* information across a communications *channel.* The medium or channel we use today might be wireline, TDMA/CDMA/DAMPS or AMPS handsets, laser beams (safely contained within fiber-optic cables, to be sure) or beams of microwave energy. All of the former fall into the RF spectrum. Moving "up" the electromagnetic spectrum and "down" in wavelength, the submillimeter signals become infrared energy. Go shorter still, and we are into X-rays, gamma-rays, cosmic-rays and—who knows?

Current technology can be "stretched," and the operating frequencies can be increased with "RF lenses." If you have worked on microwave systems, the notion of focusing the energy with a Huygens, Fresnel or Kirchoff diffraction element is probably familiar to you. A handset with extremely low energy levels and a suitable lens might give us additional spectrum to use within a portable product. It would require an *extensive* set of receiving elements—a cloud of them—to capture and translate the intelligence onto a broadband

waveguide. I see this as a maybe—*if* the modulation schemes can be sorted out. *Impulse* modulation might offer additional use of existing electromagnetic spectrum for more communications channels.

Getting past microwave, infrared may hold some promise. IR has the potential for more bandwidth—and hence more channels. Work with this technology is quite promising.

Japan Telecom and Nakayo Telecommunications are jointly developing a new hybrid communications system that combines infrared and wireless. So far, the system can transmit data at 6Mbps as far as 200m.

Nippon Telegraph and Telephone is working with IR technology for handsets. Building-interior applications, such as high-rises and subways, readily come to mind. The IR handset would have a simple waveguide; a small, clear, plastic rod would work to carry the energy, just as a fiber-optic cable does. Health and radiation concerns should be inconsequential. Watch for this technology in the near term. When last I was in Japan, there were a *lot* of tall buildings and subways, so a considerable market is available to drive development.

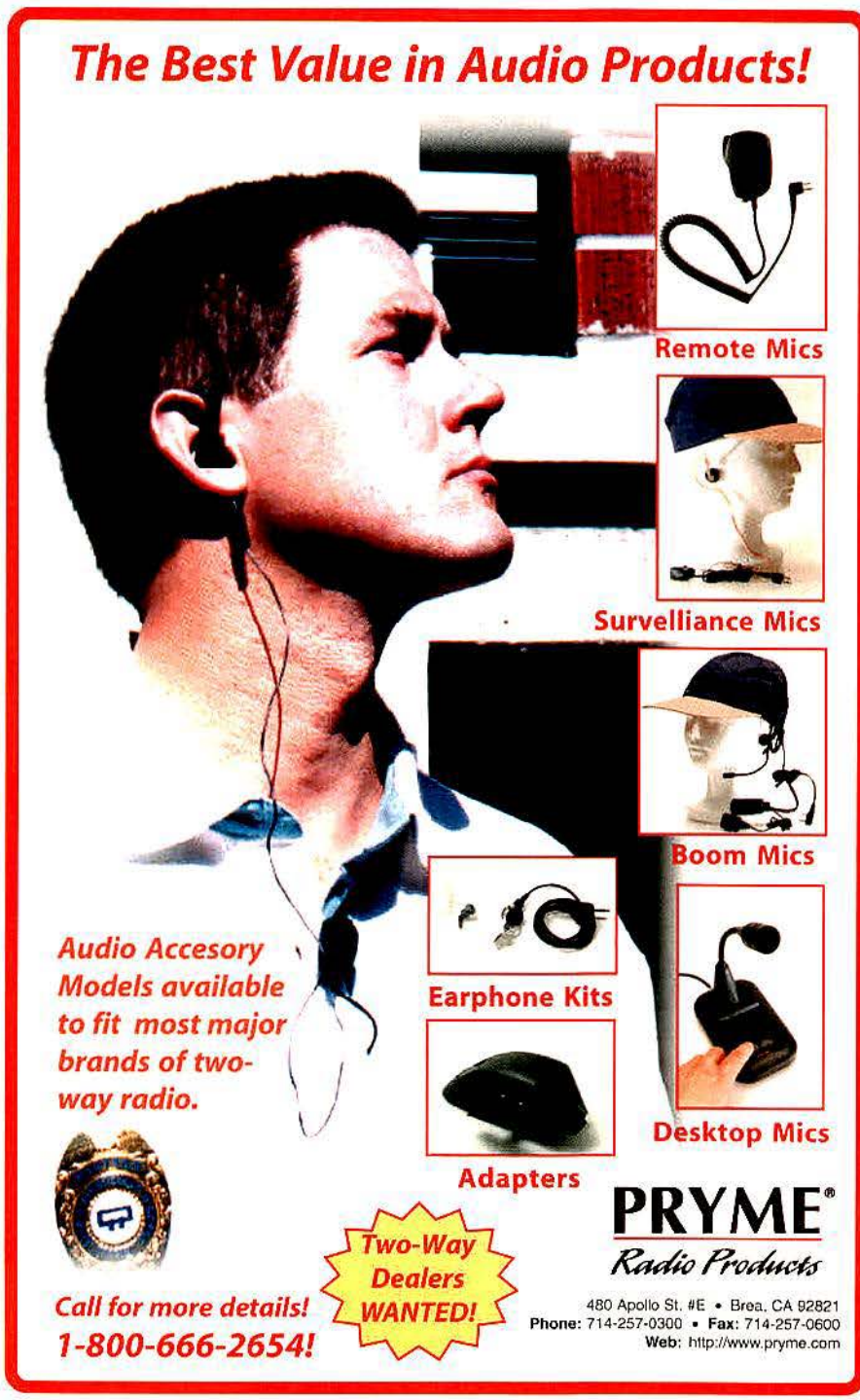
The IR handset would have a simple waveguide; a small, clear, plastic rod would work to carry the energy, just as a fiber-optic cable does.

Not all IR research is in the Orient. Current efforts by Pouyan Djahani and Joseph M. Kahn at the University of California–Berkeley deal with replacing traditional single-element receivers with imaging receivers and replacing diffuse transmitters with multibeam (quasi-diffuse) transmitters. Link-performance targets are to find the minimum transmitter power that will achieve bit-error rates of less than 10^{-9} with 95% probability.

Djahani and Kahn's results indicate that in line-of-sight links, imaging receivers can reduce the required transmitter power by as much as 13dB compared to single-element receivers. In non-LOS links, imaging receivers and multibeam transmitters may reduce the required transmitter power by as much as 20dB.

X-out the X-files

We can safely rule out X-ray and gamma-ray communications channels for portable applications. I, for one, would not stick my head into



CIRCLE (30) ON FAST FACT CARD

Will packet data become *particle* data?

For a lot of us, nuclear physics in school never got past the proton, the neutron and the electron. Here's a refresher glossary on subdividing the invisible:

Antiparticle
For most particle types (and every *fermion* type) there is another particle type that has exactly the same mass, but the opposite value of all other charges (quantum numbers). This is called the *antiparticle*. For example, the antiparticle of an electron is a particle of positive electric charge called the positron. Most *boson* types also have antiparticles, except for those that have zero value for all charges, such as a photon or a composite boson made from a *quark* and its corresponding *antiquark*. In these cases, there is no distinction between the particle and the antiparticle; they are the same object.

Antiquark
The antiparticle of a *quark*.

Baryon
A *hadron* made from three *quarks*. The proton (up-up-down) and the neutron (up-down-down) are both baryons. They may also contain additional *quark-antiquark* pairs.

Boson
A particle that has integer intrinsic angular momentum (spin) measured in units of h-bar (spin = 0, 1, 2 ...). All particles are either *fermions* or bosons. The particles associated with all the fundamental interactions (forces) and composite particles with even numbers of fermion constituents *(quarks)* are bosons.

Fermion
Any particle that has odd-half-integer ($^1/_2$, $^3/_2$ ...) intrinsic angular momentum (spin), measured in units of h-bar. All particles are either fermions or *bosons*. Fermions obey a rule called the *Pauli Exclusion Principle*, which states that no two fermions can exist in the same state at the same time. Many of the properties of ordinary matter arise because of this rule. Electrons, protons and neutrons are all fermions, as are all the fundamental matter particles, both *quarks* and *leptons*.

Flavor
The name used for the different *quark* types (up, down, strange, charm, bottom, top) and for the different *lepton* types (electron, muon, tau). For each charged lepton flavor, there is a corresponding *neutrino* flavor. In other words, flavor is the quantum number that distinguishes the different quark/lepton types. Each flavor of quark and lepton has a different mass.

Gluon
The carrier particle of the strong interactions.

Hadron
A particle made of strongly interacting constituents (*quarks* and/or *gluons*). These include the *meson* and *baryons*. Such particles participate in residual strong interactions.

Lepton
A fundamental *fermion* that does not participate in strong interactions. The electrically-charged leptons are the electron, the *muon*, the *tau* and their *antiparticles*. Electrically-neutral leptons are called *neutrinos*.

Meson
A *hadron* made from an even number of quark-antiquark constituents. The basic structure of most meson is one *quark* and one *antiquark*.

Muon
The second *flavor* of charged *leptons* (in order of increasing mass), with electric charge −1.

Neutrino
A *lepton* with no electric charge. Neutrinos participate only in weak and gravitational interactions and are therefore difficult to detect. There are three known types of neutrinos, all of which have extremely small mass.

Particle
A subatomic object with a definite mass and charge.

Quark
A fundamental *fermion* that has strong interactions. Quarks have electric charge of either $+^2/_3$ (up, charm, top) or $-^1/_3$ (down, strange, bottom) in units where the proton charge is 1.

Tau
The third *flavor* of charged *lepton*, with electric charge −1.

Source: Lawrence Berkeley National Laboratory

an operating microwave oven, and this spectrum offers that same environment for the mobile user. For extremely wide bandwidth channels that might be used in space-to-ground and space-to-space applications, it might make a lot more sense.

X-ray lasers and "grasers" (gamma-ray lasers) are operational already, and they offer tremendous potential for point-to-point channels. Issues such as radiation properties, directionality (Gaussian beams), and spatial and temporal coherence will have to be sorted out with appropriate modulation schemes before you will see these systems in use, however.

Can you channel-split an atom?

Next, we enter the realm of subatomic speculation. What about "atomic" transmissions? Can subatomic particles be coded, manipulated or transmitted as a means of communications?

There are a total of 24 fundamental particles *(see the glossary at the left)*: six "flavors" of quarks (defined in three generations of two), six leptons (also in three generations) and an equal number of antiparticles. We can combine quarks of different flavors, and all of the mesons and baryons that are known, to date, can be explained. I won't touch on bosonic particles (any of the 13 types) or neutrinos. (Do they really exist?)

Pulsed, modulated or "wobbulated," can these particles be the media of our telecommunications future? It's hard to say, but history does remind us that, at one time, we thought communications above 14 megacycles was impossible. The "state of the art" changed, and now we have 800MHz handsets to stay in touch. (As an aside, mu mesons *have* already been generated and used for laboratory-test communications ... in April, 1972!)

The process remains the same

No matter what we use as a communications channel medium, several other *support functions* must exist. I will explain by using the

current analog, then extrapolate for the future.

The National Institute of Standards and Technology establishes (what else?) standard measurements so that we can build, maintain and promote communications systems, among other things. More importantly, accurate measurements allow us to stay out of each others' hair. Interference will kill a commercial communications system faster than a tax increase.

How you might "calibrate" a lepton stream or define the "bandwidth" for bosonic-based system elements is *way* beyond me, but someone (or some agency) *will* have to establish acceptable measurement standards for manufacturers and system operators before anything can work, commercially. International (or interplanetary—who knows?) standards that use a common engineering language will be the foundation of any system.

Some kind of "Federal Communications Commission" or rather, its future analog, will be needed to define and to maintain communications channel boundaries, sort out safety issues, resolve interference and protect consumers. Industry working groups may fill this need, in addition to providing a way to establish standards for interoperability of both equipment and any accessories (such as terminals and data readers) that may be offered.

There will be a need for either venture capital for development or government-supported R&D that will then be shared with the industry. Some type of government support may be necessary until the technology matures. Free enterprisers may howl, but historically, from the early railroad system to the Internet of today, the hand of the government was necessary to midwife the complete birth of a technology.

Once the technology matures, the subsidy can be eliminated and the resulting new businesses can be taxed to recover the initial outlay. In some cases, constraint of competition may be necessary in the early days of an industry. Until they are established, markets may be limited, and expensive products have a way of going under. (Does "Iridium" ring a bell?)

Get too many players in an infant market, and competition from other technology segments will be keys to that system's downfall. (And the government can be credited for its salvation.)

"Some things never change." This is as true in the communications business as anywhere else. No matter what futuristic communications media we put into use, some functions of regulation and cooperation must be in place for new technologies to be successful. ■

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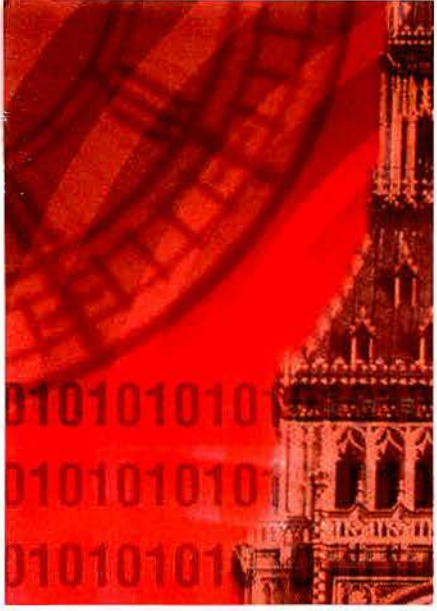
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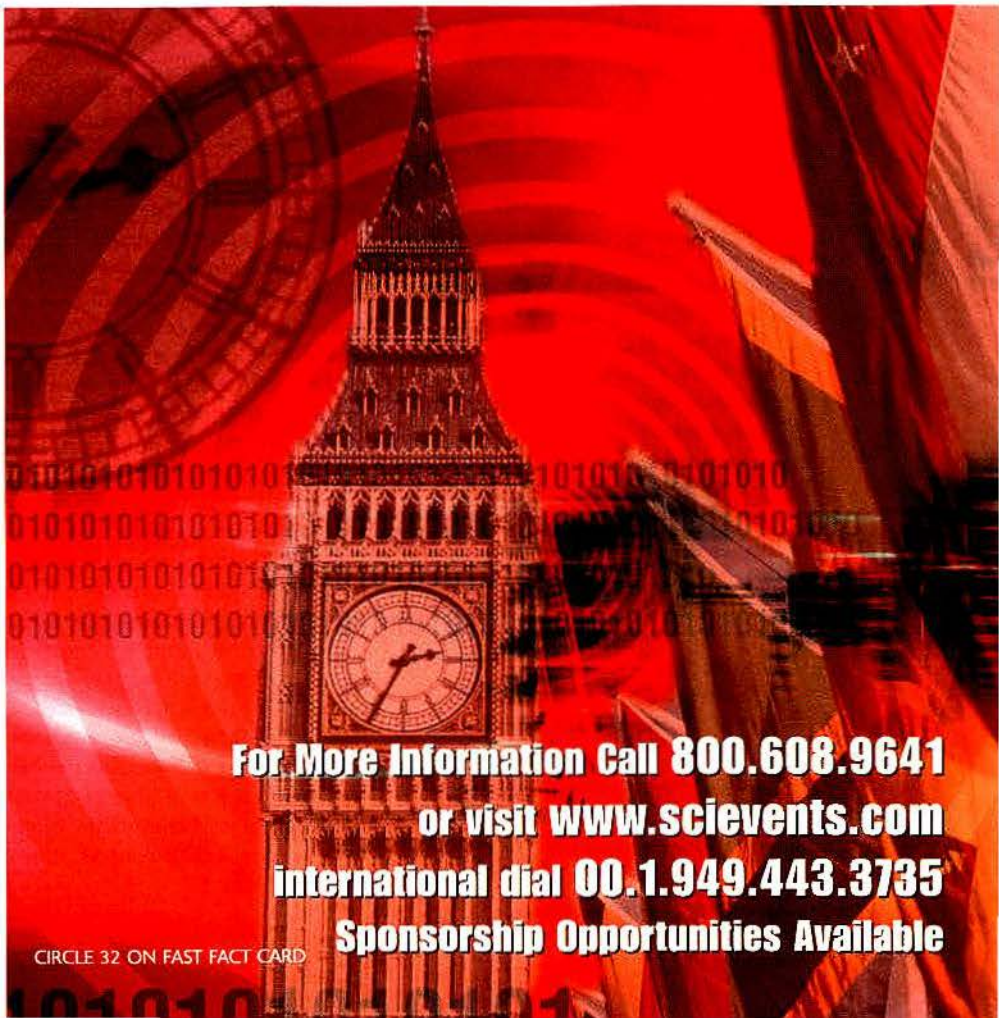
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Consolidation along the Cumberland

Partnerships between public safety agencies and publicly-owned utilities may seem unlikely. But in Nashville, the power company, the fire department and the cops not only talk to each other, they also share the radio system on which they do it.

By Leonard E. Leech and Robert T. Forrest, P. E.

Consolidated communications can work—and it can work *well*. The Nashville story is an example of how to combine public safety and utility communications into one radio system successfully.



NES's coverage area (blue) completely overlays Metro's public safety coverage requirements (green).

Utilities and public safety agencies have common needs: reliable dispatch communications (generally over a wide area) and frequency communications with workers inside buildings. Public safety incidents are frequently time-response-intensive, and utilities are also "up against the clock" when responding to outages or storm damage.

Exploiting synergies

Where utility and public-safety service areas coincide, it makes technical, operational and economic sense to consider consolidation into a common communications network. A typical solution has been a common, trunked, wide-area infrastructure (generally in the 800MHz band). This allows each public-safety and utility agency to operate independently under routine conditions, but they can interact to join forces as the situation demands.

The benefits of consolidation for the utility are significant. Teaming with public safety produces a "public-safety grade" system that allows intense communications over a wide area in an integrated network situation. It also adds a dimension of reliability and redundancy not usually present in a small utility-owned system.

By teaming with public safety, the utility is generally considered a public-safety entity and therefore shares radio channels that otherwise would be exclusively allocated to public-safety agencies. Potential economic benefits are subtler and depend on the ownership and operational management structure. The public entity may also be able to bring low-interest municipal money into the partnership.

Benefits for the public-safety organization are also significant. The utility owns rights-of-way, which facilitate fiber placement for the network backbone. Utility-owned property can be used for tower sites. Antennas can also be collocated on existing transmission towers (which sometimes speeds the permitting process). A utility is staffed by technical people—and is focused on business. This is a real plus at procurement time, and the utility may be able to use a different or innovative procurement approach, whereas the public-safety agency is bound by state and local procurement regulations.

Mutual benefits to public safety and utilities are even greater. Economy of scale can cut the cost of the common infrastructure by as much as 50%. A larger system with pooled radio channels provides capacity beyond the sum of the capacities of two or three smaller systems, due to economies produced by traffic-loading processes. Interoperability during emergencies is in the public interest, and each service gains all of the "eyes" of the other in identifying and reporting incidents or problems. If a lineman reports a traffic accident, or a police officer alerts the utility that a line is down, both entities benefit.

Metro Nashville/NES System

Metro Nashville (Nashville and Davidson counties) and the Nashville Electric Service have undertaken such a communications partnership. Over the past four years, the Metro/NES partnership has realized a vision of a common communications system.

NES is a municipal electric utility and a distributor of Tennessee Valley Authority power. With more than 300,000 customers, NES is 11th in the nation among local publicly-owned electric systems. NES is 12th in revenue at $664 million and 12th in megawatt-

Leech is engineering manager for Nashville Electric Service, and Forrest is president of CTA Communications, Lynchburg, VA.

hour sales at more than 11.5 million MWh. The utility operates in a 700-square mile area bisected by the Cumberland River, as shown in the map on page 38. (The areas served outside of the jurisdiction of the metro government are shaded more lightly.) NES averages peak loading of about 2,400MW.

Until 1994, the NES radio system consisted of six base stations at separate sites. Mobiles were primarily operating at 158MHz on four channels from five sites (one back-up site). At that time, the system suffered many drawbacks:

- ❑ insufficient coverage (dead spots).
- ❑ inadequate channel access during peak periods.
- ❑ insufficient capacity.
- ❑ old and substandard system.
- ❑ unsatisfactory site security.
- ❑ no expansion frequencies available for data communications.

The Metropolitan Government Public-Safety systems also suffered many drawbacks. Police were using VHF highband, while fire and rescue were on UHF. Seven repeater locations were used. Metro maintained 52 separate radio channels. Users relied on cellular for data transmission.

A study completed in August 1994 cited the following deficiencies:

- ❑ insufficient system capacity.
- ❑ system aging.
- ❑ south and central sectors at saturation point.
- ❑ no expansion frequencies available for data communications.
- ❑ no expansion frequencies available for proposed new sectors.
- ❑ system designed before current, upgraded radio standards.
- ❑ inadequate coverage and poor in-building reception of portable radios becoming a safety issue. At the same time, portable usage was increasing downtown (for foot and bicycle patrols) and within special-needs buildings (police school-services officers).

During this time period, NES had already done a needs analysis and had begun the procurement process. With FCC refarming and other operational considerations coming into play, the utility had decided to independently purchase an 800MHz simulcast trunked radio system. Somewhere during the process of addressing the needs of the public-safety system, however, the Metropolitan Finance Director's office became aware of NES's own plan to replace its radio system. NES's management was contacted, and meetings were held with police and other public-safety entities to determine the feasibility of a shared system. Based on the needs of the respective agencies, a new direction was proposed:

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- ❑ joint-venture procurement.
- ❑ Metro would handle the purchasing process.
- ❑ specify an 800MHz trunking system with simulcasting (to provide virtually countywide coverage inside buildings).
- ❑ use existing towers and sites (considerable cost savings).
- ❑ NES and Metro Government would be "back-ups" for one another.

Overcoming barriers

Some barriers to cooperation existed. Both organizations had communications staffs that had managed quite nicely without interacting with the other agency (aside from disputes over frequencies).

Another issue was a prohibition in the NES/TVA power contract against co-mingling of funds. TVA essentially regulates distributors of TVA energy, so this provision is common in TVA power contracts. It is designed to keep city or county governments from using their utility as a revenue source for city projects.

Other questions raised by the prospective partners included:

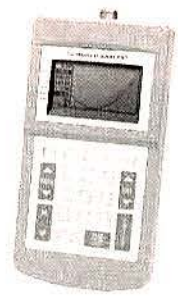
- ❑ Who will "own" the system?
- ❑ How will initial system expense be allocated?
- ❑ How will ongoing expenses be allocated?
- ❑ Who will operate and maintain it?
- ❑ Who benefits—and how?

Necessity dictated the identification of a win-win solution. To facilitate cooperation on the project, a memorandum of understanding between the Metro and NES was developed. The MoU established that a common goal was for both parties to achieve significant monetary savings. The MoU gave Metro the responsibilities to assign engineering work, to let bids, to award construction contracts, and to purchase necessary facilities and equipment. The NES was responsible for funding its portion of the undertaking and participating in all the jointly used equipment and facilities.

A factor attractive to both parties was an opportunity to share costs and to reduce the final expense to each party. The total Metro cost of the hardware infrastructure and mobile/portable radios was estimated at that time to be $27.1 million over four years.

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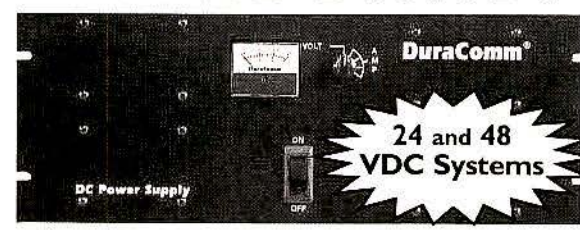
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licensing considerations at the time. Once the 800MHz licenses were awarded, the agencies would have three years to construct the project; consequently, a decision needed to be made quickly. If they waited, they would forfeit the "window of opportunity" to acquire the then-available 800MHz licenses. Delay or indecision would require them to use the National Public Safety Planning Advisory Committee bands that were estimated to cost from $3 million to $10 million dollars more to implement.

There were also public relations considerations at this point (particularly for the public-safety side):

- potential liability (officers unable to communicate because of radio problems).
- use of citizens band radios and cellphones (some police officers were using their own CBs because of radio problems).
- shared system had a lot of taxpayer (Metro) and ratepayer (NES) appeal.

Getting underway

The project comprised four phases: needs assessment, procurement, implementation and acceptance.

▶ *Needs assessment* – It is important not only to obtain inputs from all user agencies but also to make them feel that they are an important part of the process. This is particularly important in a system that will be shared by multiple jurisdictions and a utility.

▶ *Procurement* – The Metro Nashville procurement process was a multistep process. It began with a prequalification phase that weeded out any firms that were either weak financially or did not possess the technology or experience required to build a high-level system. This process resulted in two qualified vendors.

The second phase was to request an unpriced technical proposal from each of the prequalified vendors. Rather than rate each proposal at this stage, Metro negotiated with each proposer to adjust the specifications so that each vendor could submit a compliant proposal with no exceptions. At the same time, separate contract negotiations (terms and conditions) were conducted with each vendor. Two weeks after the final technical proposal was due, the vendors were required to submit their price proposals. Because both vendors were required to submit fully compliant technical proposals, and the contracts were already negotiated, the lowest-price proposal would govern who got the award. In this particular case, one of the vendors was not comfortable with the required system design and dropped out.

▶ *Implementation* – During implementation, Metro and NES participants were active members of a fleet-mapping subcommittee. All major decisions were made jointly by Metro and NES, and both took part in all status meetings. They were also both part of the formal correspondence transmittal system.

▶ *Acceptance* – The system was accepted for use by Metro/NES in March 2000, after a comprehensive series of tests were passed. Final acceptance followed the resolution of minor punch list items and final documentation approvals.

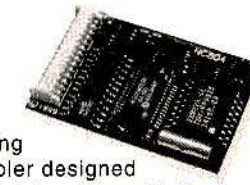
The learning curve

Success is defined as "a favorable or prosperous termination of anything attempted." By that measure—by *any* measure—the Metro Nashville/NES project is a success. The system is up and running, it meets the needs of the users, it came in within a reasonable target of the budget and it was built within a reasonable period of time.

▶ *What went right?* – Good communications characterized the team: Metro/NES (the owner), CTA Communications (the engineer) and Motorola (the supplier). Everyone was aware of what was going on at all times. The review process included teleconferences and meetings, and the transmittal process included the entire team on every issue. Where side discussions occurred (as they must—

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Views of the prime site (Compton) with the new tower adjacent to the old tower-vintage 1951.



The new tower is 480 feet tall.

and will anyway) between two team members, they were not ratified until all three entities had reviewed them.

The specifications were written to reflect the needs of the users, and the procurement process was set up so that the entire team approved any changes made in the specifications. The contract reflected the specifications, and the project reflected the contract. This process did not happen automatically—it took constant vigilance among all participants.

Coverage performance exceeded expectations. Because the contract required a coverage guarantee, Motorola was naturally conservative in its estimate of coverage. The result was that when the system was tested for coverage, it passed by a substantial margin. Nothing pleases an owner more than getting more than it expects. Costs and change orders were also kept to a minimum.

▶ *What were the challenges?* — Siting and locations were a problem. It is never too soon to get sites locked down (although you must wait until the supplier is on board to learn if the supplier is going to guarantee coverage). Acceptance and the "end game" schedule were delayed. There are always things that come up at the last minute. Some tests will fail and will need to be re-run after solutions are applied.

Communications problems, of course, will exist among people. You cannot have too much communications among team members. The challenge is to make sure all this communication happens without creating a bottleneck.

The project did not have true competition in procurement. While the intention of the procurement was "competitive negotiation" between two or more suppliers, in actuality, other vendors dropped out along the way leaving this to be a negotiated procurement between Motorola and Metro/NES.

The specifications and request for proposal were acknowledged by all to be open and fair, but sometimes circumstances overcome good intentions. The negotiations were cooperative. However, from the perspective of the owner, there is obviously more leverage when there are two or more supplier participants.

One word of caution: You must approach specification and procurement with an unqualified commitment to openness, fairness and impartiality. There must be an

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absolute commitment among all owner participants that you will accept the results—even if someone might wish the results had turned out differently.

Metro had a "landmark" tower downtown at the "Compton site" that needed rebuilding. This tower was originally built in 1951, and many people would cite it for navigating the streets of Nashville. Unfortunately, Metro/NES found out a year into the project that the tower just couldn't take the antenna load at the level of confidence required by current standards. Reinforcement of the tower was considered and dismissed because the foundation had deteriorated too much. The decision was made to *rebuild* the tower at the *same location*. This required construction of a second tower immediately adjacent to the original, transfer of the equipment from the original to the new tower and dismantlement of the original. The photo on the facing page shows both towers in the middle of the process—after the new tower was constructed and before the old tower was removed.

▶ *Lesson learned* — Experience with the Nashville project demonstrated that:

- ❑ Things sometimes take longer than anticipated when more individuals are involved.
- ❑ Tower siting is not a "slam-dunk"—even when it *is* in the public-safety interest.
- ❑ Tower siting is also not a "slam-dunk" even when all you are doing is replacing an existing old tower with a new one at the same location.
- ❑ Agencies *can* work together.
- ❑ Agencies can benefit from each other's experiences.

A win-win result

The project has benefited NES and its ratepayers—they are part-owners of a radio system that performs at a public-safety level. The cost of this performance is probably less than could have been achieved independently because the systems are not redundant, as originally envisioned. While some may argue that the extra level of performance is not necessary for utility communications, the fact remains that electric companies, firefighters and police work hand-in-hand during emergencies.

The Metro government benefits from a new public-safety radio system operating at a lower cost to the taxpayers. This benefit made it possible to provide digital field units as opposed to staying with analog technology.

Without good communications among the team members, and trust on the part of all, the project will probably not proceed in a satisfactory manner. With communications and trust, the inevitable challenges can and will be overcome. ■



Pot-luck progress

The Nashville Metro/NES system consists of two 18-channel trunked simulcast systems operating in tandem in the 806MHz to 824MHz range. NES brought 10 channels to the consolidation, and Metro brought 30 channels.

The system requires two control channels and currently has two channels designated for data and two channels designated for AVL. There are three telephone interconnect lines (two for NES and one for Metro). The system will support digital or analog transmission. There are 24 dispatch consoles installed at the 9-1-1 (Compton) site and six remote consoles at NES sites. These six consoles are connected back to the central electronics bank via an NES-supplied OC3 SONET ring over leveraged fiber. The seven tower sites are interconnected by a fully protected microwave system operating at 6GHz. By the beginning of 2001, Metro was slated to have 3,000 portables and 2,000 mobiles. NES was scheduled to have 375 portables and 100 mobiles in service.

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Happy 25th, IWCE!

'70s party, car giveaway mark celebration

With more than 350 exhibitors of land-mobile related equipment and services, the International Wireless Communications Expo has come a long way since 1977, when it started out as the National Business Radio Dealer's Conference. More than 7,500 people attended the show this year, an increase over last year.



For IWCE's 25th anniversay, five companies pitched in to give away a 2000 Volkswagen Beetle.

Several special events marked the occasion of IWCE's 25th anniversary. Exhibitors attended a 25th anniversary '70s party Tuesday night before the show, where a slide show presented industry events from the past 25 years. And thanks to IWCE's "premier partners," one fortunate attendee won a 2000 Volkswagen Beetle on the last day of the show. (The partners included ComSpace, Kenwood Communications, Motorola, Futurecom and Vertex Standard.)

Conference sessions included three tracks: the business and technology track, the regulatory track and the public safety track. Subjects covered the status of channels 60–69 and how to survive and win the auction process. The public safety track expanded to include the latest information on interoperability, TETRA and 700MHz.

Public safety proved to be a priority at IWCE this year (see "Public Safety: '10-2'," page 14). The keynote speaker was the chair of the Public Safety National Coordination Committee, Kathleen Wallman. Exhibitors included public safety associations such as the Public Safety Wireless Network Program and the Association of Public-Safety Communications Officials–International.

IWCE 2002 will be held April 24–26 at the Las Vegas Convention Center. (**www.iwceconexpo.com.**)

Seventy-seven companies join IWCE event

Some of the companies represented on the exhibit floor of IWCE 2001 have long been a part of the show's history. These exhibitors have witnessed an evolution of technology and a parade of new faces visiting their booths during "the" radio show.

This year, a significant number of "first-time" exhibitors joined the hustle and bustle of the expo—almost 80, to be more specific. The addition of these exhibitors was cause enough to celebrate IWCE's 25th birthday. You can review a list of these companies by accessing the "New Exhibitor" menu item from the home page of IWCE Live! The link is on the *MRT* site (**www.mrtmag.com**).

An important subset of this roster, however, is the international list of new exhibitors. Seven companies from outside the United States are represented in this year's exhibitor lineup. They are: Airtech Information & Communication Company, South Korea; Cape Communications UK Ltd., UK; Multitone Electronics, UK; No Wave, Sweden; Commtech Wireless Pty, Ltd., Australia; SCUD Fujian Electric Co. Ltd., China; Union China Limited, Hong Kong. —*RI*

RCA breakfast draws overflow crowd

The Radio Club of America (RCA) annual breakfast was attended by more than 140 RCA members and guests. Event sponsors included *Fryer's Site Guide & Tower Source,* RadioMate, Schwaninger & Associates and Small Business in Telecommunications.

Bob McGowan, chair of the American Mobile Telecommunication Association and president of FleetTalk Partners spoke to attendees about the "death of dispatch." McGowan noted that cellular has raised the expectations of users and is challenging two-way radio with such systems as Nextel's direct-connect service.

In spite of the challenge being offered by cellular, McGowan said that the demand for dispatch services will increase. He noted that transportation, real-estate, oil and gas, and government markets are prime candidates for dispatch growth.

However, to become attractive to these markets McGowan presented a "wish list" that would support growth. He said the government must provide enough spectrum to make the market attractive to service suppliers and OEMs. His list also included: a high-quality, market-priced radio; a first-class dealers organization; availability of wide-area systems; a cost-effective path to digital technology; reliable customer service support and client retention and a federal government that understands how dispatch services significantly contribute to the nation's economy. —*RL*

This year marked the 25th anniversary of the International Wireless Communications Expo, held in Las Vegas in March. Between the 350+ booths, special events, conference sessions and prize giveaways, visitors to IWCE were kept busy.

SBT 'Jam Session' highlights registration technology

Regulations and technical advances that may challenge and benefit small telecom businesses were explored during the annual Small Business in Telecommunications pre-IWCE 'Jam Session' at the Alexis Park Hotel on March 27.

The five-hour conference program was interleaved with technical and informational presentations by manufacturers and business services sponsoring the event.

Presentations included an overview of potential conflicts between local-exchange carriers and paging providers over which will bear the costs and technical responsibilities for digital trunk SS7 (signaling system 7) implementation. Vic Jackson, of Vic Jackson Interconnection Services, outlined the LECs' responsibilities and methods paging providers can use to convert SS7 to MF signaling. Jackson said this technology interface challenge will affect interconnected SMR carriers in ways similar to those experienced by cellular and PCS providers.

Francisco Montero, former director of the FCC's Office of Communications Business Opportunities (now a partner in the Washington law firm Shaw Pittman), described FCC successes and shortcomings in accommodating small telecom business interests in the 1990s. Montero forecasted that the OCBO, created under then-Chairman Reed Hundt, may have its activities distributed among other bureaus under current FCC Chairman Michael Powell.

Brian Seedle, director for Fylde Microsystems Ltd., previewed his Wednesday IWCE presentation on the future of wireless. Seedle explored similarities and differences between U.S. and European technical standards and business models. Matching range and coverage to those models is a key issue, Seedle said: "If you don't get the range right, your business case falls to pieces." Seedle also urged small commercial service providers to investigate new technologies personally, without relying exclusively on information from the industry press, analysts or standards committees.

SBT General Counsel Robert H. Schwaninger Jr., of Schwaninger & Associates, updated attendees on a still-active U.S. Court of Appeals challenge to FCC 800MHz auction procedures. He also discussed efforts to keep customer lists confidential during relocation negotiations with auction winners. How guardband managers may distribute spectrum, dubious tower consolidation activities and spectrum caps were also discussed.

The general counsel's associate, attorney Delaney DiStefano, discussed rules and procedures for the upcoming paging auction on June 26, when more than 15,000 upperband and lowerband licenses will be offered.

Sponsor presentations included techniques supporting equipment distribution and order accuracy by Primus Electronics; optimization of automatic vehicle location data by King Communications; and new approaches for small-business financing by Arbitronix Financial Services, Lauderhill, FL.



Comspace outlined its progress in equipment type-acceptance and Digital-Channel, Multicarrier-Architecture base stations and mobiles. DX Radio Systems previewed its announcement of an MPT-1327 overlay with LTR for UHF fleet dispatch over wide-area multisite systems.

SBT Chairman Lonnie Danchik conducted a written poll of conference attendees asking what they perceive as the most serious challenges to building future business. The top response: FCC rules and regulations. *–DK*



Com-Net said to become part of M/A-COM

The Lynchburg, VA, *News & Advance* reported in its April 4 issue that Pittsburgh-based Com-Net had agreed to sell its radio equipment manufacturing subsidiary to M/A-COM, Lowell, MA.

It was only 15 months ago that Com-Net, a systems integrator, acquired what then was Stockholm-based LM Ericsson's Private Radio Systems Division in Lynchburg.

M/A-COM is owned by Harrisburg, PA–based Tyco Electronics, which in turn is a part of the Tyco International family of companies operated from headquarters in Pembroke, Bermuda.

Reporter Chris Flores learned the news from a Com-Net employee. The employee attended a meeting on April 3 in Lynchburg facilities where most of the subsidiary's 651 employees work. That's when the sale of the Com-Net Ericsson Critical Radio Systems subsidiary was announced privately. As of April 17, Com-Net Ericsson had posted a link to Flores' *News & Advance* story on its home page (**www.com-netericsson.com**). The link read that Com-Net had signed an agreement with M/A-COM, pending government approval.

Tyco International's annual report indicates that the company has $29 billion in annual sales. That figure will be boosted when various pending acquisitions close. Tyco has been on a buying spree:

▶ On March 13, Tyco announced an agreement to acquire New York–based CIT Group, a commercial finance company, for the equivalent of $9 billion in stock.

▶ On Feb. 5, Tyco announced an agreement to acquire Cleveland–based Scott Technologies, a designer and manufacturer of respiratory systems and other life-saving devices for the firefighting and aviation markets, for the equivalent of $400 million in stock.

▶ On Jan. 31, Tyco announced an agreement to form a joint venture worth $400 million to deploy, own and sell bandwidth capacity on the Eastern Mediterranean undersea fiber-optic system of the TyCom Global Network. TyCom would be the majority owner of the venture, with Tel Aviv–based Bezeq International holding roughly a 20% share.

▶ On Jan. 5, Tyco acquired Westminster, MA–based Simplex Time Recorder for $1.15 billion in cash. Simplex manufactures fire and security products and communications systems including control panels, detection devices and system software. Simplex also installs, monitors and services fire alarms, security systems and access control systems.

▶ On Dec. 29, 2000, Tyco acquired Lucent Technologies' Power Systems business unit for $2.5 billion in cash. The unit provides energy solutions and power products for telecommunications service providers and for the computer industry.

It was only 15 months ago that Com-Net, a systems integrator, acquired what then was Stockholm–based LM Ericsson's Private Radio Systems Division in Lynchburg. Before Ericsson bought it, the business unit was the General Electric Mobile Communications Division.

In the land-mobile radio industry, M/A-COM, with 2,800 employees, is best known for its contract to build a statewide radio communications system in Pennsylvania using its OpenSky digital radio architecture. The system can use different brands of routers, servers and other parts of the computer-based network. The system is scalable, allowing small systems to have as many features as a big system, an aspect that is appealing to the public-safety community—which also likes the system's use of off-the-shelf components.

Previous to OpenSky, M/A-COM's land-mobile radio industry presence had mainly involved supplying passive antenna-site components. The company has not had an especially well-known name or a broad line of conventional and trunked radio products. The purchase of Com-Net's radio manufacturing division would allow it to serve a bigger part of the market and would give it a large dealer network. —*DB*

Datamarine to acquire 220MHz systems from SMR Advisory Group

Datamarine International, Mountlake Terrace, WA, has agreed to acquire eight 220MHz, five-channel Phase I systems in Washington and Oregon from SMR Advisory Group, a Texas limited-liability company.

The eight systems and attendant licenses will be acquired for about one million shares of Datamarine common stock, valued at $1 per share, plus warrants that have variable terms regarding price and quantity. The price will relate the exercise date to the date of issuance of the warrants. Included in the price of the systems are all of the associated base-station equipment and the current subscribers.

The acquisition is subject to due diligence, compliance with applicable FCC, federal and state securities laws, and the approval of the owners of each of the systems.

David Thompson, Datamarine president, said that this further acquisition of 220MHz spectrum is a reflection of the company's growing confidence in the substantial market for low-cost voice and data dispatch service.

www.mrtmag.com

MRT has two more ways to be contacted. Send your comments, suggestions and opinions to mrt@intertec.com.

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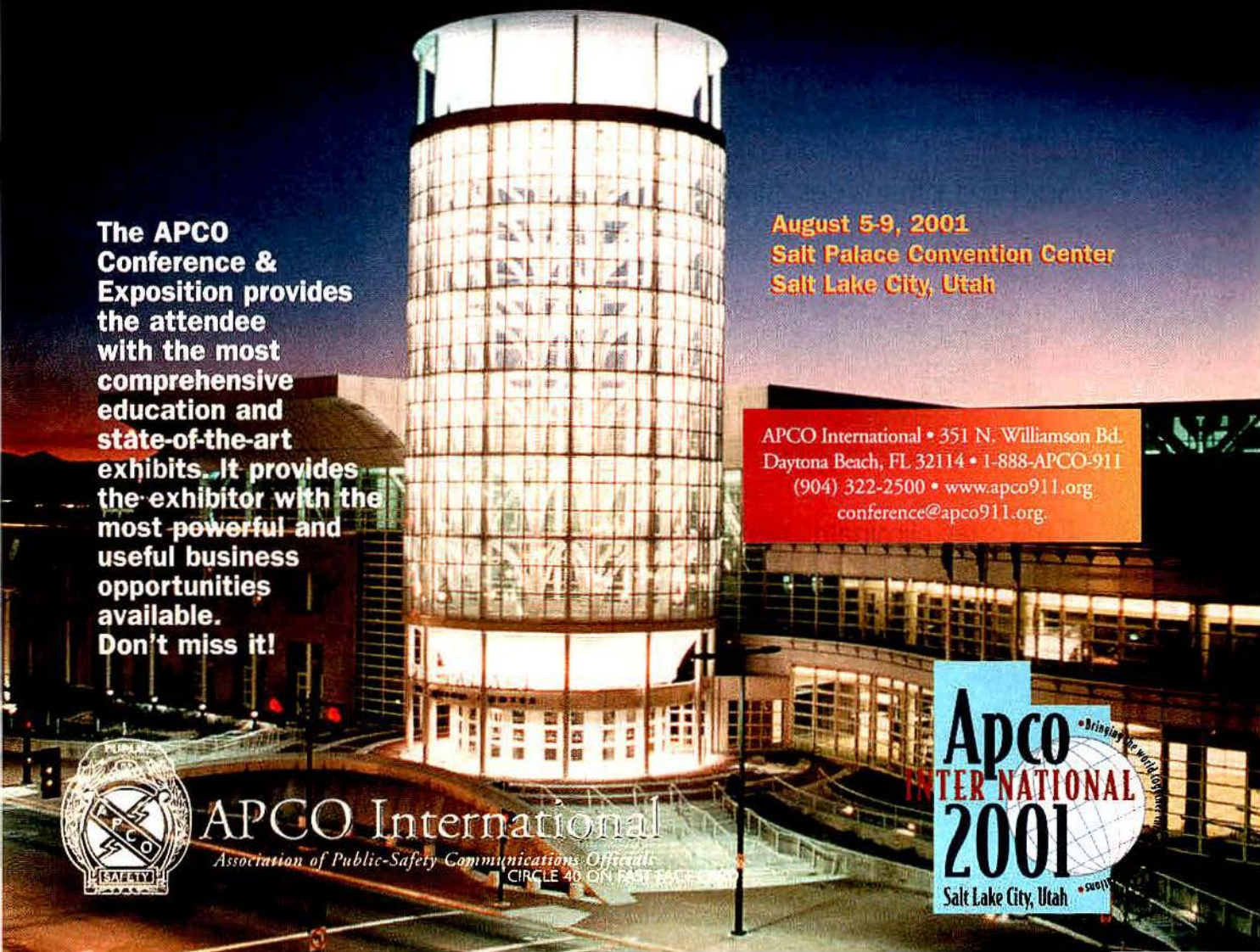
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Power supplies provide reverse polarity

Designed for base-station installation, the PS15A and the PS20A from **Geiger Communications** are



power supplies equipped with reverse polarity and short-circuit protection to minimize risk due to improper installation or use. These products incorporate switching technology and also allow operation on either 110Vac or 220Vac. The PS15ABB and PS20ABB offer a battery charger and switching circuitry to automatically revert to battery mode if the ac power is interrupted, with no interruptions in vital communications networks. With the optional hoods, any mobile can be converted to a reliable base station.

WWW.GEIGERCOMM.COM

Power system includes battery backup

The N+1 power system from **Samlex America** is expandable by 20A modules from 40A–100A. Additional features include a built-in battery backup



module with charging capability for external batteries, remote monitoring and indication, and V/A meter and operation LEDs. This system was designed using switch-mode technology and load-share circuitry. At 100 continuous-duty amps, the unit weighs 25 pounds.

WWW.SAMLEXAMERICA.COM
OR 800-561-5885

Supplies offer sleek fit with any mobile radio

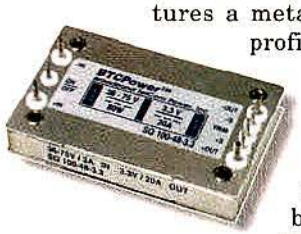


The Comm series 10A, 11A and 12A switching power supplies from **ICT** are designed to provide a sleek fit with any mobile radio. These supplies are available in three case sizes: AX (5.6"), AG (6.4") and A (7.1"). These supplies are lightweight, cost-effective and minimize desktop clutter.

WWW.ICT-POWER.COM OR 604-888-6304

Converter eliminates need for filtering devices

The BTCPower SQ series from **Broadband TelCom Power** features a metal-shielded, low-profile, 100W quarter brick designed to prevent EMI and thus eliminating the need for ferrite beads or other EMI/RFI filtering



devices. This shield also acts as a heat dissipating medium with large surface area, therefore eliminating the need for heat sink or forced air-cooling. Delivering 20A with efficiency (90%@5V), this model is useful for the high-energy power needs of the telecommunications industry.

WWW.BTCPOWER.COM
OR 714-259-4888

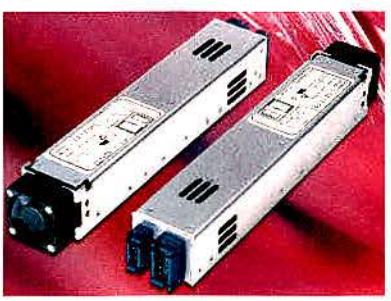
System incorporates power accessories



Newmar's Integrated Power System incorporates built-in battery backup, power accessories and auxiliary power inputs within a single 2RU (3.5") chassis. This eliminates the need for system integration, component sourcing and installation. A regulated power supply/charger, backup battery, low-voltage battery disconnect and output metering are all pre-wired and calibrated within the unit for plug-and-play operation. Plug-in terminals are provided for easy wiring of a parallel rectifier, or external batteries for increased backup capacity.

WWW.NEWMARPOWER.COM
OR 714-751-0488

System allows flexibility



Deltron's L series is a compact hot swap, 200W power supply series in a 1U high package that provides system designers flexibility in placing system power. These power supplies provide 7W per cubic inch. Units can be used alone or combined to provide multiple outputs for powering a wide variety of computing and telecommunications applications. Features of the single-output L series include a 0.95 power factor and 80% efficiency. These supplies are self-cooled with an integral ball bearing fan and feature an enclosed chassis.

WWW.DELTRONINC.COM

Ad Index

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Antennas work in 800MHz, 1,900MHz

Kathrein, Scala Division, has developed antennas for wireless carriers having spectrum in the 800MHz and 1,900MHz range. The antennas are 65° sector, cross-polarized products. Various configurations of gain and downtilt are available. All models contain independent cross-polarized antennas for the two wireless bands. There are four bottom-mounted RF connectors, one for each 45° and –45° array in each band, permitting the use of polarization diversity at 800MHz and 1,900MHz. Each band array is equipped with adjustable electrical downtilt controls. A future option will permit downtilt for each array to be controlled remotely.

WWW.KATHREIN.COM

Product Encore

Of the new products in the September 2000 issue, this one generated the biggest reader response. For more information on this product, log on to **www.pryme.com.**

Flexible antenna operates on two meters, 440MHz

The RD-8 rubber duck antenna from **Pryme Radio Products** is a 6.5" flexible antenna that will operate on two meters and on 440MHz. The antenna is designed for dual-band hand-helds that offer 800MHz and 900MHz receive. It is equipped with a 900MHz resonator and offers a gold-plated BNC connector.

WWW.PRYME.COM



Cables simplify, speed-up cable connection

Rapid Fit from **Radio Frequency Systems** is a line of single-piece coaxial cable connectors. These connectors provide connector-to-cable interface while simplifying and speeding up the attachment of connectors to Cellflex coaxial cables. These connectors offer quick and easy installation at any location, thereby allowing the operator flexibility. This product has a mechanical design so it registers low VSWR, and low and stable intermodulation levels. The connectors are waterproof so they provide safe, long-term operation in harsh environments and conform to IP66 and IP68 requirements. These connectors are also tested for mechanical and electrical compliance with IEC/DIN/MIL specifications. They are available in type N and 7/16 DIN interfaces.

WWW.RFSWORLD.COM OR 203-630-3311

DSP-based tone adapter provides control



The DSP-223 from **Telex Communications** is a DSP–based tone adapter panel that provides a means of remotely controlling two-way radio base stations. The adapter panel can be used with consoles that use the industry-standard, high-level tone-sequential format. This adapter features front-panel test points and level-adjustment potentiometers, six digital outputs for channel selection, a microphone jack and frequency selection standard with F1–F99. Also included are CTCSS regeneration, programmable single or duel-function tone, loop-back test tone for level adjustments and morse code encoder.

WWW.VEGA-SIGNALING.COM

Switch monitors hot-standby capability

The Tracer protection switch from **Adtran** provides monitored hot-standby capability for Tracer digital microwave radio systems. Located between two identical 2.4GHz or 5.8GHz radios that share a single antenna, this product monitors the primary radio for alarm conditions. In the event of a primary radio alarm, the signal is automatically switched to the backup radio unit to ensure continued operation of the system.

WWW.ADTRAN.COM

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CIRCLE (41) ON FAST FACT CARD

Antenna made with strong materials

Antenex's fiberglass-enclosed base antennas are for the 2.4GHz band. These 3dB gain antennas have the same outer shell design used in the company's lower-frequency fiberglass-enclosed base stations. These antennas also have a high-gloss, heavy-wall fiberglass radome; a finish-ground, schedule-80, gold anodized aluminum sleeve for mounting; and a gold anodized aluminum cap. On the inside it features a rigid low-loss PC board trace used for the construction of the collinear radiator. The product also features a nickel-plated brass N female connector in the base for feed line connection.



WWW.ANTENEX.COM OR 800-323-3757

Router combines IP routing, DSX-1 interface

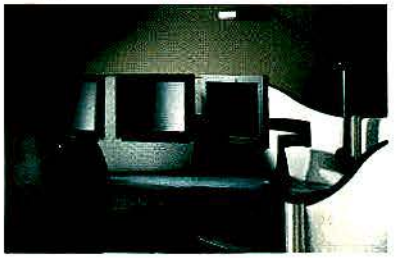
The Tracer 2631 from **Adtran** is a license-free digital microwave radio that provides wireless IP routing capability and digital voice transmission. This router uses spread-spectrum technology, allowing carrier and enterprise customers to extend LANs to previously unreachable locations.

WWW.ADTRAN.COM



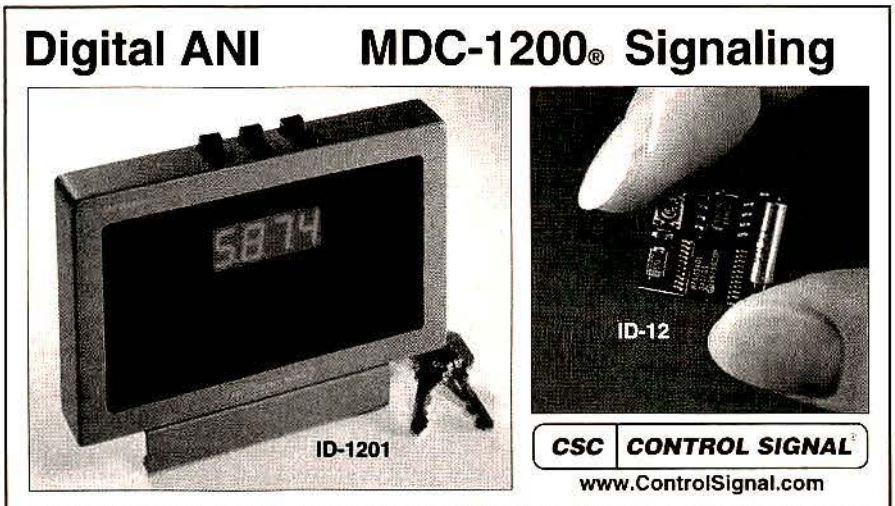
CIRCLE (42) ON FAST FACT CARD

Furniture offers ergonomic features



Fusion from **Watson Furniture** is a line of dispatch console furniture. It is an ergonomically engineered and functional workstation. This console offers user-friendly features such as a power-adjustable work surface to accommodate a variety of users at the same work space, personal temperature controls and noise reduction. Research and development resulted in a design that increases work surface area.

800-426-1202



CIRCLE (43) ON FAST FACT CARD

Mounts allow positioning of mobile screens



Mobile video mounts from **PanaVise** allow easy installation and positioning of mobile video screens in a variety of vehicle locations. All mounts have a standard T-bolt for most video screens and other mobile electronics with T-slots. Using these mounts avoids damage to headliners or headrests. Several mounting options are available for installers including flex mounts, pedestal mounts, a T-bolt adapter for use with AMPS-compatible phone mounts and in-dash custom dash mounts.

WWW.PANAVISE.COM OR 775-850-2900

Antennas suit rugged environments

The N2400SM9 and the N24-HGARSM1B from **NCC** are portable antennas useful for rugged environments. The unity-gain (2.14dBi), halfwave design suits hand-held applications. The N2400-SM9 incorporates a reverse polarity SMA connector, is injection molded in polyurethane and comes in standard black or gray, with other colors available on request. The N24-HGARSM1B is a high-grain collinear antenna in the 2.4GHz band. The antenna has a multi-positionable articulating mount and is available in various SMA connector styles. The antenna is also useful for WLAN applications.



WWW.NCCMUNSON.COM
OR 440-548-5384

Surge suppressor offers flexibility



The Interceptor II from **Liebert** is a surge suppressor with a durable and flexible design for almost any application or environment. The system offers a high level of protection with built-in testing and a small, space-saving footprint. This product uses technology to handle greater surge current and lower clamping voltages for mission-critical systems. Because of this, the Interceptor II is useful for applications such as telecom, wireless and broadband systems that include sensitive equipment housed in remote or unmanned shelters. This product is also suitable for commercial, industrial and institutional facilities for protecting entire structures against the devastating effects of a lightning strike or other dangerous power disturbances.

WWW.LIEBERT.COM
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CIRCLE (44) ON FAST FACT CARD

Precision adapters operate in 34GHz

The precision adapters from **RF Connectors** are used in microwave and RF applications. This 3.5mm series has a bandwidth through 34GHz, and a VSWR of 1.05 + 0.004F (F = GHz). They also intermate with 2.9mm and SMA connectors and adapters. Female contacts feature a four-slot configuration ensuring that pressure is distributed evenly during the engagement of the male pin. This design, when combined with a shortened male pin, eliminates misalignment during engagement. All bodies are stainless steel with a captivated dielectric bead and gold-plated BeCu contacts. Adapters available include male to male, female to female, male to female and female to female bulkhead with o-ring seal.

WWW.RFINDUSTRIES.COM

Changing Channels



Truthan

Changes at Antenna Specialists, Cleveland, OH:

Robert Truthan, senior antenna engineer, advances to director of engineering. **Anne Housholder** leaves Anderson BDG in Allentown, PA, to become application support specialist.



Housholder

Motorola appoints **Timothy Cawley**, former president of SBC Communications/Europe, to corporate vice president and general manager of Motorola's personal communications sector's North American region.

Magnus Ojert departs Nextel, where he was vice president of network engineering and operations, to become the chief operating officer of qServe Communications, Greenville, SC.

Annette Gieseman, vice president of Xybridge Technologies, Richardson, TX, leaves to become vice president of ComSpace, Coppell, TX.

Alan ElShafei, formerly of TDI Batteries, Romeoville, IL, joins JBRO Batteries, Lisle, IL, as vice president of engineering and business development.

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CIRCLE (46) ON FAST FACT CARD

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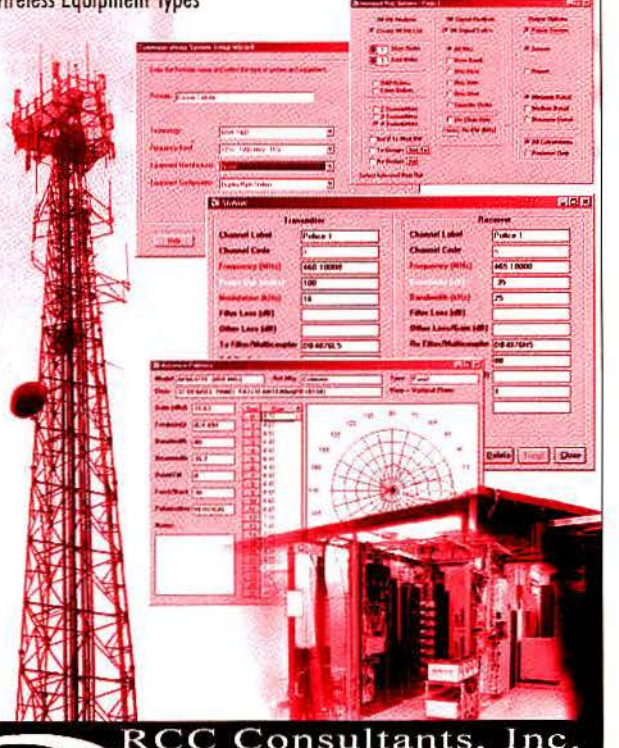
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6–9: Spring Vehicular Technology Conference, sponsored by the IEEE Vehicular Technology Society, David Intercontinental Hotel, Tel Aviv, Israel. Contact: 972-3-6133340 or **congress.co.il/ieee_news/index1.html.**

8: Tennessee Region 39 700MHz Planning Committee meeting, Ellington Agricultural Center, Nashville. Contact: John Johnson, 615-741-3826, **jjohnson@tnema.org.**

8–9: EPRI Powering the Digital Economy Workshop, Westin Crown Center, Kansas City, MO. Contact: Lea Ann Lawson, 865-218-8028.

13–17: APCO East Coast Regional Conference, sponsored by the Association of Public Safety Officials–International, Lancaster Host Resort, Lancaster, PA. Contact: Jay Groce III, 610-344-5084.

16–18: PCIA Tower and Site Management Conference, sponsored by the Personal Communications Industry Association, Doral Golf Resort and Spa, Miami. Contact: 703-739-0300.

21–24: Telecommunications Resellers Association Spring Conference and Exhibition, sponsored by TRA, Adam's Mark Hotel, Dallas. **www.tra.org.**

June

3–7: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

24–27: UTC Telecom, sponsored by UTC, the United Telecom Council, Midwest Express Center, Milwaukee. Contact: 202-857-1881 or **www.utc.org.**

24–28: NENA, sponsored by the National Emergency Number Association, Orlando, FL. **www.nena9-1-1.org.**

28: NPSPAC Region 24 800MHz Committee meeting, Missouri State Highway Patrol General Headquarters. Contact: Steve Devine, 573-526-6105.

July

15–18: Forestry Conservation Communications Association National Conference, Olympia, WA. **www.mashell.com/~roblee/fcca.htm.**

17–18: European Business Wireless Congress, sponsored by IWTA, Prague. Contact: Ryan Cleveland, 202-331-7773.

August

5–9: Association of Public-Safety Communications Officials–International (APCO) National Conference, Salt Lake City. Contact: 904-322-2500 or **www.apco-intl.org.**

September

11–14: PCIA GlobalXChange, sponsored by the Personal Communications Industry Association, Los Angeles Convention Center, Los Angeles. Contact: 703-739-0300 or **www.pcia.expo venture.com.**

19–22: Private Wireless Spectrum Management Conference & Expo, sponsored by Industrial Telecommunications Association, the Council of Independent Communications Suppliers and the USMSS, Grand Hyatt Hotel, Washington. Contact: Ray Wisniewski at 703-528-5115 or email: **ray@ita-relay.com.**

November

6–8: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888, ext. 102, or **www.cwta.ca.**

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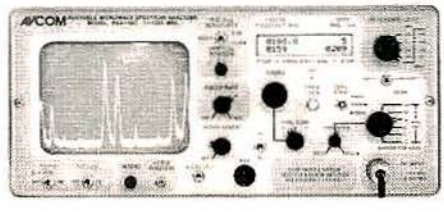
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* Motorola MSF 5000 Repeaters	28
* Smartnet Spectra C7 Mobile	535
* Spectra C7 Control Stations	8
MTS 2000 Portable Radios	26
Centracom Series II Phis consoles complete with CEB	6
* Harris 6 Ghz Digital Microwave system (5 sites)	

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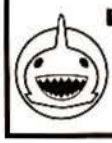
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30	MOTOROLA MAXTRAC 800 Mhz B5	$100 ea
30	GE G-Marc 6615	$75 ea
20	GE G-Marc 6825	$100 ea
20	GE G-Marc MDS (TL 600)	$75 ea
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10	MOTOROLA MICOR 800 Mhz Conv. RPTR 75W PA w/Duplexer	$1,200 ea
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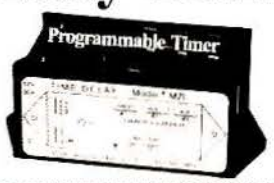
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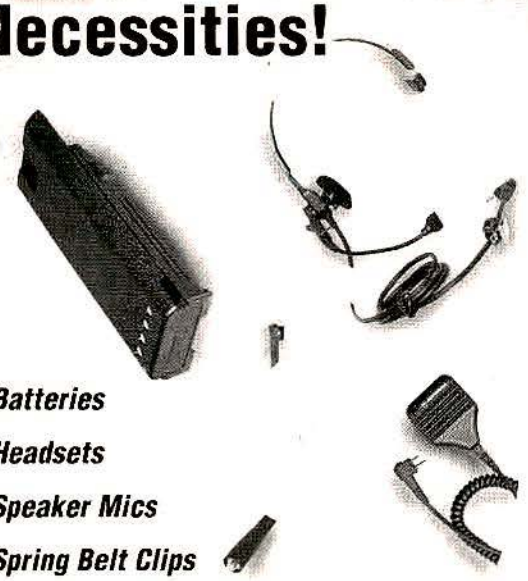
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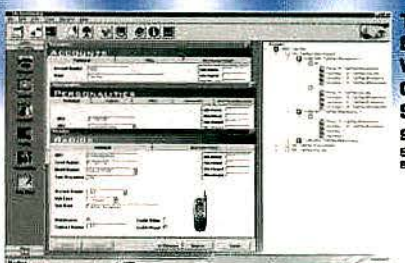
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Keep on dancing



First off, let me thank all of you who welcomed me to the world of mobile radio at the International Wireless Communications Expo. I'm excited about the opportunity to work with the dynamic *MRT* team. I've worked with the *MRT* staff for the past five years as editor for *RF Design* magazine. So, when asked to *join* the *MRT* staff, I jumped at the opportunity.

I am no stranger to the world of mobile radio. As a career U.S. Air Force avionics and aircraft maintenance officer, I worked with a number of airborne and ground communications systems. I have been accused of telling "war stories," so I won't begin here. However, if you ever see me at a conference or trade show and want to exchange "life experiences," I'm your man. From working with legacy systems, acquiring new technology, and adapting old and new technology to old and new applications, I had my share of the good and the bad that communications technology has to offer.

Then the music started, and the go-go dancers (guys and girls) started dancing. Next thing I know, I'm being dragged out onto the dance floor.

Because of (or in spite of) my experiences, you will find I can be passionate about issues that affect how communications technology evolves and how it is applied. So, don't be too surprised to see me rant in this column. I am opinionated, and I'll take on anything I see that needs to be addressed. So, when I do rant, I want to hear from you. I actually answer my phone and my email.

IWCE was lively

If you missed this year's IWCE, you missed an outstanding event. This was my fourth IWCE, so I went off to Las Vegas thinking I had everything well-in-hand. Wrong. This time, no one told me I needed to take dancing lessons before I got there.

First of all, the 25th anniversary celebration had a '70s theme. That was cool. But then the music started, and the go-go dancers (guys and girls) started dancing. Next thing I know, I'm being dragged out onto the dance floor.

Well, I survived that, only to be invited to the Kenwood event held at the Harley-Davidson cafe. What a great event. But, guess what—more music and (gasp) dancing. While the rest of the *MRT* staff got out there, I hid with the rest of the "too cool to dance" crowd. (In other words, the rest of the cowards.)

Both events were a lot of fun and very lively. And speaking of lively, have you checked out the *IWCE Live!* Web site? Just go to the *MRT* Web site at **www.mrtmag.com** and click IWCE Live!. The *MRT* staff, supported by the *RFD* editors, did a real-time, online update of what was going on at IWCE. From news events to new product releases, the site was a fun ride to keep updated. It will be online for at least another month, so check it out. You may even find a picture of an editor (who will go nameless) dancing.

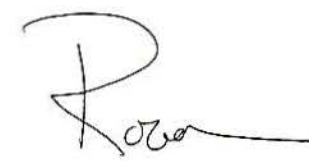
Two-way or not two-way

So, is two-way radio dead? I think not. Nor did the keynote speaker at IWCE. Nor did the keynote speaker at the Radio Club of America breakfast. Nor did those of you I talked with at IWCE. While cellular has presented a challenge, two-way technology still dominates.

Although there are a number of growth areas, one of the strongest is public safety. As regular readers know, *MRT* has been focusing on public safety issues, applications, technology and products for a number of years. You will see us continue to address public safety and its communications requirements.

This is important to me. You see, I live in Littleton, CO, and just minutes away from Columbine High School. I was personally touched by events there. I was frustrated and upset over the lack of communications interoperability among police and other responding agencies. What really added to my ire was the fact that I saw the same interoperability issues among the services while I was in the Air Force. The military has been slow to respond to this issue (while it is a heck of a lot better, it still needs work), and I see the same slow response in public safety areas. Creating a "hub" to pass messages is not a solution. If anything, it only drags response capability down.

Are there solutions? You bet there are. In the pages of *MRT*, we will continue to point out how the issues are being addressed and what solutions are out there. But, let me know what you think. E-mail me directly at **rlesser@intertec.com.**



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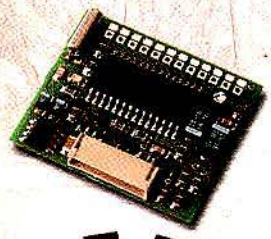
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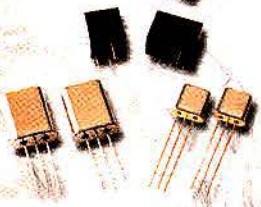
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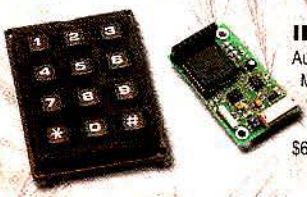
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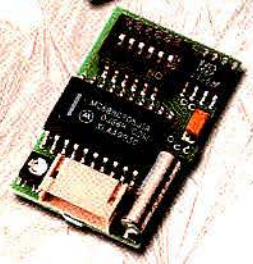
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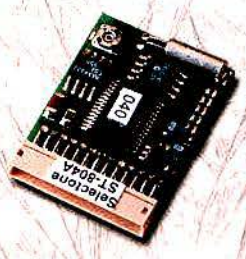
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